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NORTHEAST ELECTRONICS CORPORATION

P.O. BOX 649 – CONCORD, N.H. 03301

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INSTRUCTION MANUAL

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FOR

TTS 37E

TRANSMISSION TEST SET

NORTHEAST ELECTRONICS CORPORATION

P.O. BOX 649 – CONCORD, N.H. 03301

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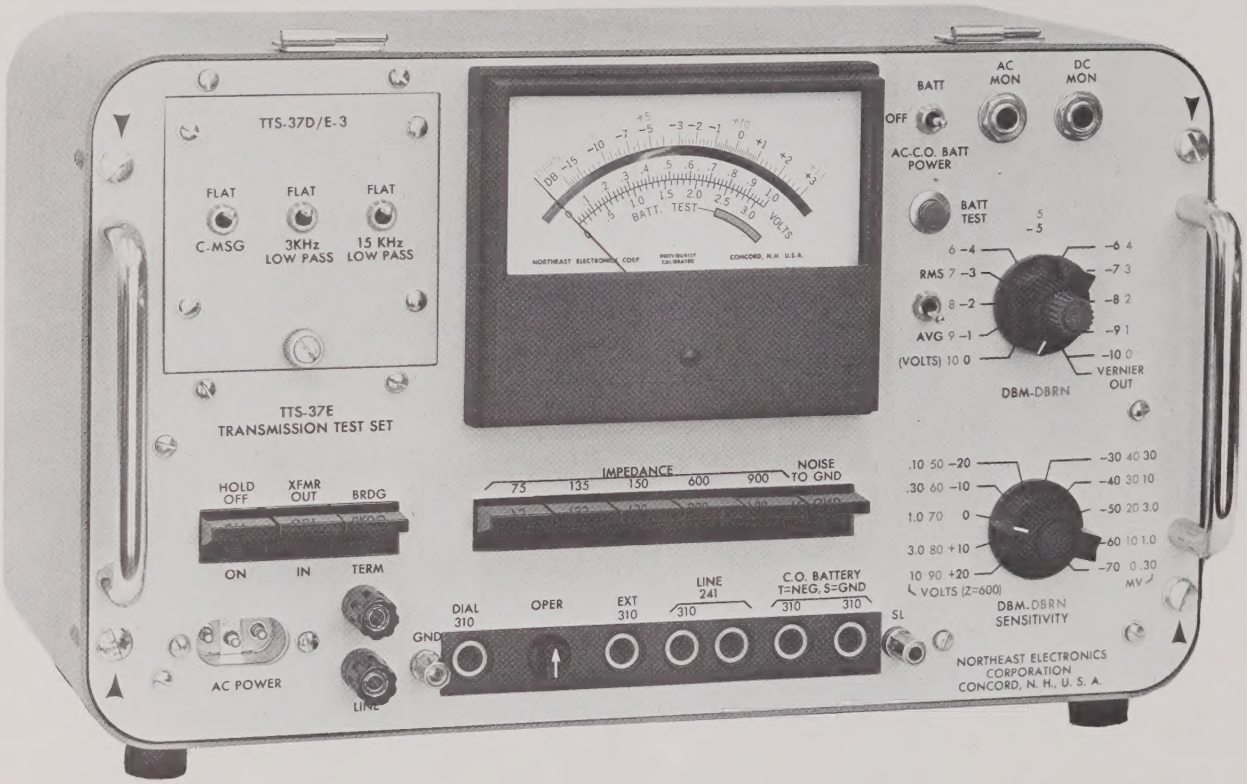
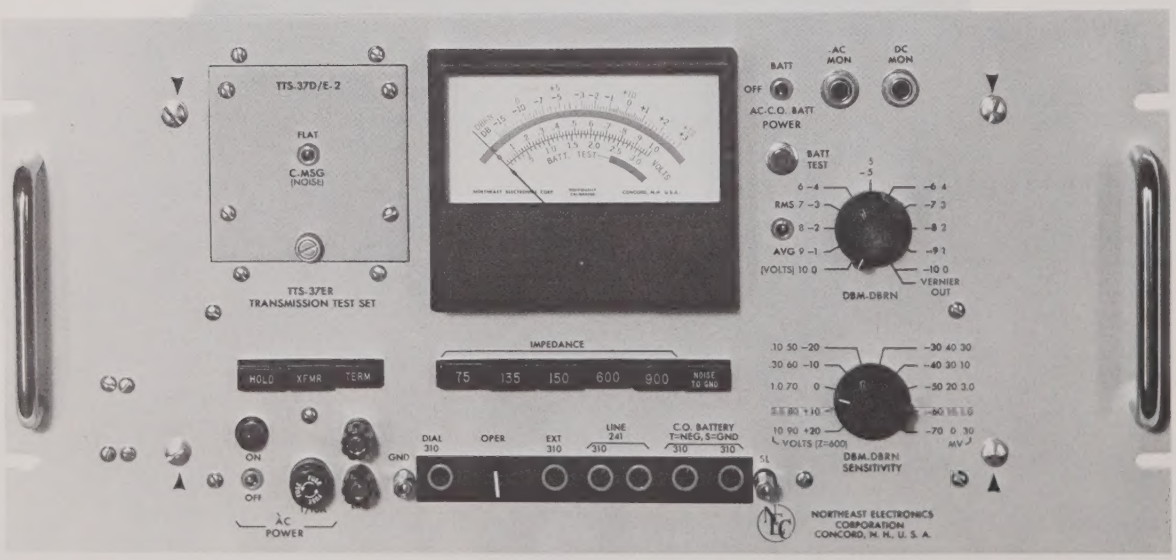


TTS 37E Transmission Test Set (Portable)



TTS 37ER Transmission Test Set (Rack Mounted)

SECTION 1

DESCRIPTION & SPECIFICATIONS

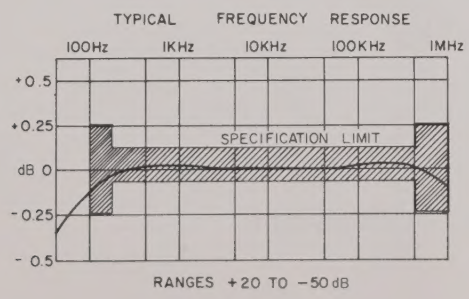
1.1 GENERAL. The Model TTS 37E is a transistorized transmission and noise measuring test set designed to measure wide-band transmission levels to 1 MHz, noise levels and AC voltages. Two SENSITIVITY attenuator switches (10 dB/step, 1 dB/step) provide sensitivity settings from +20 dBm to -80 dBm. This, when combined with the meter scale, permits measurements from +23 dBm to -95 dBm. Other markings on the meter and the SENSITIVITY switches permit noise measurements directly in dBrn from -5 dBrn to 113 dBrn. Two AC voltage scales on the meter and markings on the 10 dB/step SENSITIVITY switch permit AC voltage measurements from 0.3mV to 10V full-scale.

1.2 The set is equipped with an interchangeable plug-in module that permits the addition of a variety of filters and networks. (Refer to the TTS 37D/E series).

1.3 The set can be switched to measure on circuits with impedances of 75, 135, 150, 600 or 900Ω on either a bridging or terminated basis. Noise to ground measurements can also be made with a 40 dB loss. Provisions for dialing on the line under test are provided by the use of a hold circuit and a key switch that transfers the input circuit to the dial jack. Monitoring jacks for AC and DC output signals are provided.

1.4 All input and output connections to the set are made through jacks normally used in the telecommunication industry. In addition, universal binding posts are provided in parallel to the tip, ring and sleeve of the input jacks.

1.5 The set operates from 115V ac, central office battery (-24 to -70V) or internal batteries. The cover is removable and provides storage for the power cord. A rack-mounted unit designated the Model TTS 37ER is also available.



1.6 SPECIFICATIONS

ACCURACY: ±0.1 dB 1000 Hz 0 dBm 600Ω
0°C to 50°C

STEP ATTENUATOR ERROR: ±0.2 dB + 20 dB to -70 dB

1.6 SPECIFICATIONS

ACCURACY: ±0.1 dB 1000 Hz 0 dBm 600Ω
0°C to 50°C

STEP ATTENUATOR ERROR:
±0.2 dB + 20 dB to -70 dB
±0.1 dB + 10 dB to -60 dB

EFFECT OF BATTERY VOLTAGE:
Less than ±0.05 dB error (within or above the green arc marked BATT TEST)

TERMINATING IMPEDANCES: 75, 135, 150, 600, 900Ω ±10%

BALANCED BRIDGING INPUT IMPEDANCE (1000 Hz): 100KΩ without transformer
20KΩ with transformer

INPUT BALANCE:
With transformer: 80 dB 50 Hz-10 kHz
Without transformer: 60 dB 50 Hz - 10 kHz
40 dB 50 Hz - 100 kHz

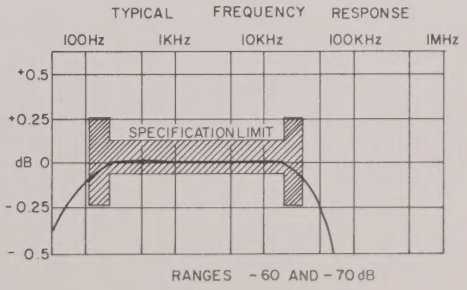
NOISE TO GROUND MEASUREMENT: 100KΩ either side to ground, 40 dB attenuation.

DETECTOR: Absolute average or RMS, selected by switch

POWER: Internal batteries (12 D Cells)
Central office batteries (24V to 60V)
115V ac 50-400 Hz 5 watts

SIZE: Model 37E - 14"w x 8"h x 9"d (7" case, 2" cover)
Model 37ER - 8¾ x 19" (23" adapters available on request)

WEIGHT: Approximately 20 lb.



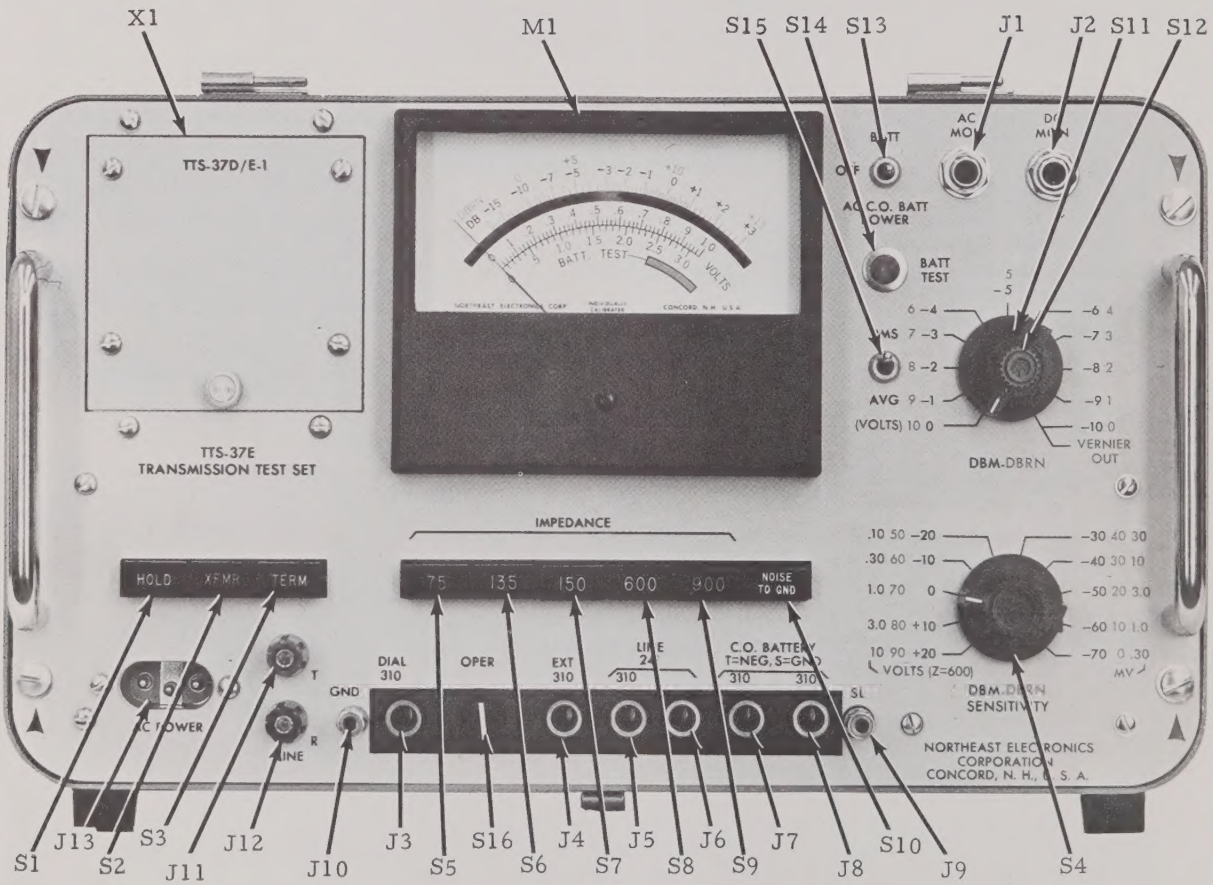


Fig. 2-1 Front Panel Controls

SECTION 2

OPERATING INSTRUCTIONS

2.1 FRONT PANEL CONTROLS (Fig. 2-1 and Table 2-1 locate and describe the front panel controls of the TTS 37E.)

Ref. Desig.	Name of Control	Type of Control	Use or Purpose
S13	BATT/OFF/AC-CO BATT POWER	Toggle switch	Applies power to the set and provides a choice of power modes.
J1	AC MON	Jack for 310-type plug.	Provides AC monitoring.
J2	DC MON	Jack for 310-type plug.	Provides DC monitoring.
S14	BATT TEST	Pushbutton switch	Permits testing of internal batteries.
S15	RMS/AVG	Toggle switch	Determines mode of detection
S11	DBM-DBRN	Rotary switch	1 dB/step attenuator.
S12	VERNIER OUT	Potentiometer/ snap switch, concentric with S11.	±1.5 dB/step attenuator.
S4	DBM-DBRN SENSITIVITY	Rotary switch	10 dB/step attenuator.
S5-S9	IMPEDANCE (75, 135, 150, 600, 900)	Pushbutton switch with interlocking action.	Permits selection of desired termination impedances.
S10	NOISE to GND	Pushbutton switch with interlocking action.	Provides measurements of noise to ground levels.
J3	DIAL 310	Jack for type 310 plug	Provides a connection for a dial set.
S16	OPER	Turnbutton switch	Disconnects the input circuit from line under test while dialing.
J4	EXT 310	Jack for 310 type plug	Provides an input using a 310 type plug in parallel with Line 310.
J5-J6	LINE 241	Jack for dual 241 telephone	Provides an input using a dual 241 type plug.

Ref. Desig.	Name of Control	Type of Control	Use or Purpose
J5	LINE 310	Jack for 310 type plug	Provides an input using 310 type plug.
J7-J8	CO BATT T=NEG S=GND	Jacks for 310 type plugs	Inputs for central office battery power.
J9	SL	Binding post	Connected in parallel with sleeve of input jacks.
J10	GND	Binding post	Connected to circuit ground (chassis) and is electrically insulated from either tip or ring inputs.
J11	LINE T	Binding post	Connected in parallel with tip of input plugs.
J12	LINE R	Binding post	Connected in parallel with ring of input plugs.
J13	AC POWER	AC receptacle	Provides connection to AC power source.
S1	HOLD	Pushbutton switch with interlocking action.	Places hold coil across the input.
S2	XFMR	Pushbutton switch with interlocking action.	Inserts isolation transformer at the input.
S3	TERM	Pushbutton switch with interlocking action.	Permits selection of bridging or terminated measurements.
M1	METER	dBm/dBrn/volts	Provides readout.
X1	FILTER MODULE	Plug-in module	Optional equipment for the selection of various filters.

2.2 OPERATION

2.3 INITIAL STEPS. The following steps should be taken to prepare the set for operation.

a. Unlatch and open the cover. The cover can easily be detached by sliding it to the right.

b. Select the desired power source. Use the following procedure to operate from the selected power source:

1. 115V ac - remove the power cord (supplied with the set) from the line cord holder located on the inside of the cover. Connect the line cord to the AC POWER jack and to a suitable source of 115V ac power. Operate the power switch to the AC-CO BATT position.

2. CO BATTERY - connect a cord equipped with a 310 type plug into one of the CO BATTERY 310 jacks first. Connect the other end of the cord to the CO BATTERY power source. (-24V to -70V dc) (T=NEG, S=GND). Operate the power switch to the AC-CO BATT position. Depress the BATT TEST pushbutton and observe if the meter needle deflects into or beyond the green arc (BATT TEST) denoting the correct polarity and sufficient voltage to operate the set. When disconnecting the set, remove the cord from the power source first. Both CO BATTERY jacks are connected in parallel to allow patching of CO Battery power to another unit.

3. Internal Batteries. Operate the POWER switch to the BATT position. Depress the BATT TEST pushbutton and observe if the meter deflects into or beyond the green arc (BATT TEST) denoting good batteries.

2.4 LEVEL MEASUREMENTS

a. Select the desired input impedance by depressing the corresponding IMPEDANCE pushbutton switch.

b. Select either a BRDG or TERM mode of input impedance by use of the TERM pushbutton.

c. Select the mode of detection of the meter, either RMS or AVG, by use of the RMS/AVG switch.

d. Place all filter switches in the FLAT position.

e. Connect a circuit to be tested to either the LINE jacks (EXT 310, LINE 310 or LINE 241) or the LINE binding posts.

f. Set the SENSITIVITY switches (10 dB/step and 1 dB/step) to obtain a convenient reading on the meter. A more accurate measurement may be obtained if the meter needle falls between the black numerals +3 and -3 dBm.

g. The input level being measured will be the algebraic sum of the settings of the SENSITIVITY switches and the meter reading. Be sure that the VERNIER OUT is in the out position.

Example:

Sensitivity 10 dB/step	Switches 1 dB/step	Meter Reading	Level
+10 (BLK)	-3 (BLK)	+2.0 (BLK)	+9.0 dBm
+20 (BLK)	-5 (BLK)	-3.0 (BLK)	+12.0 dBm
0 (BLK)	0 (BLK)	-1.6 (BLK)	-1.6 dBm

2.5 NOISE MEASUREMENTS

a. Select the desired input impedance by depressing the corresponding IMPEDANCE pushbutton switch.

b. Select either a BRDG or TERM mode of input impedance by use of the TERM pushbutton.

c. Place the RMS/AVG switch in the RMS position.

d. Select the desired filter. (Refer to the TTS 37D/E series, option section.)

e. Set the SENSITIVITY switches (10 dB/step and 1/dB step) to obtain a convenient reading on the meter. A more accurate measurement may be obtained if the meter needle falls between the blue numerals +7 and +13 dBrn.

f. The input level being measured will be the algebraic sum of the settings of the SENSITIVITY switches (blue numbers) and the meter readings (blue numerals only).

Example:

Sensitivity 10 dB/step	Switches 1 dB/step	Meter Reading	Level
30 (blue)	7 (blue)	+7 (blue)	+44 dBrn
40 (blue)	5 (blue)	+10 (blue)	+55 dBrn
50 (blue)	0 (blue)	+12 (blue)	+62 dBrn

2.6 VOLTAGE MEASUREMENTS

a. Place the IMPEDANCE switch in the 600 position (depressed).

b. Select either a BRDG or TERM mode of input impedance by use of the TERM pushbutton.

c. Select either an RMS or AVG mode of meter detection by use of the RMS/AVG switch.

d. Set the 1 dB/step DBM-DBRN SENSITIVITY switch to the VOLTS position (0 dBm), and make sure that the VERNIER OUT is in the OUT position.

e. Set the 10 dB/step DBM-DBRN SENSITIVITY switch to obtain a convenient reading on the meter. This switch setting (red) represents the full-scale reading for that position.

2.7 AC MONITOR. To AC monitor an input signal, insert a 310 type plug (tip and ring) connected to an earphone, such as the NEC TN 45 or equivalent, into the AC MON jack. This output jack can be connected to any 600Ω impedance receiving device with little effect on the meter reading.

2.8 DC MONITOR or RECORD

a. Follow steps a through f under paragraph 2.4.

CAUTION: Neither the tip or ring connections on the DC MON jack are connected to ground; therefore, the DC monitoring device must be isolated from ground and have a relatively low input impedance in order of 600Ω.

b. Connect the monitoring device to the DC MON jack using a 310 type plug (tip and ring connections). If the monitoring devices output impedance is correct, there will be no change in the reading on the meter.

c. Approximately 0.1 mA of current is supplied at the DC MON jack with a meter indication of 0 dBm at any level.

2.9 TRANSFORMER - Depress XFMR pushbutton to place an isolation transformer in the input. To remove the transformer, depress the pushbutton and release.

2.10 TO DIAL & TALK

a. Turn the OPER switch to the horizontal position.

b. Connect a dial or similar device to the DIAL 310 jack using a 310 type plug (tip and ring).

c. Connect a line to be dialed to the input (LINE 310, EXT 310, LINE 241 or the LINE binding posts).

d. A number may now be dialed on the circuit connected to the input.

e. To hold the circuit that has been dialed, depress the HOLD pushbutton. To release the circuit, depress the pushbutton and release to the normally out position.

f. To talk on the line, remove the dial from the DIAL 310 jack and insert a telephone set into the DIAL 310 jack. (tip and ring connections).

g. Connection is now established to the circuit connected to the LINE jacks.

SECTION 3

CIRCUIT DESCRIPTION

3.1 GENERAL. The circuit description of the wide band transmission and noise measuring set is presented in two parts, Block Diagram Circuit Description and Detailed Circuit Description.

3.2 BLOCK DIAGRAM CIRCUIT DESCRIPTION (See Fig. 3-1.)

3.3 A signal to be measured enters the input jacks and is presented to the input circuitry. As a safety measure, any dc voltage that enters the set is blocked from the rest of the circuitry by a 100μF non-polarized 150V capacitor. At this point, the following functions may be applied; hold coil, transformer and terminating resistors (HOLD, XFMR or TERM). Depressing the HOLD pushbutton switch places a hold coil across the line; depressing the XFMR pushbutton switch places an isolation transformer into the line, and/or by depressing the TERM pushbutton switch switches the selected input impedance from a bridging mode to a terminating mode of operation. From this point, the input signal enters an attenuator network where a high input impedance (100KΩ) is presented and adjustments for high frequency response, balance and attenuation are provided.

3.4 The output of the input network is fed into the balanced amplifier which is a dual input, single-ended amplifier which provides 10 dB of gain, provides different terminating impedances (75, 135, 150, 600 and 900Ω) and a means of measuring noise to ground.

3.5 At this point in the signal path, a receptacle is placed in the circuit to receive one of several plug-in network modules which are optional equipment. (Refer to TTS 37D/E series.)

3.6 The output signal from the plug-in module next enters a level adjustment network which is comprised of an attenuator and two switchable amplifiers.

a. The attenuator provides 30 dB of attenuation in 10 dB steps. The amount of attenuation placed in the circuit is dependent on the position of the SENSITIVITY switch (S4).

b. The first of two amplifiers is a 20 dB amplifier that is only used in the two most sensitive positions (-60 and -70 dBm), and has a bandwidth limited to 100 kHz.

c. The second amplifier is switchable from 20 dB to 30 dB of gain in 1 dB steps by the DBM/DBRN switch (S11).

3.7 The Q-RMS DETECTOR is the last circuit to receive the input signal. In this circuit the AC signal is converted to a DC signal so that it can be applied to a meter movement. The detector has a sensitivity of -20dBm and two modes of operation, RMS and average responding, selected by means of the RMS/AVG switch (S15). It has provisions for AC and DC monitoring of the input signal, accessible at the AC MON (J1) and DC MON (J2) jacks.

3.8 A voltage of -12V dc is the regulated voltage necessary for the proper functioning of this transmission measuring set. The power supply will produce a regulated -12V dc from any of three power sources, 115V ac line, central office battery power (-24V -70V) dc) or internal batteries (18V dc).

3.9 DETAILED CIRCUIT DESCRIPTION (Refer to Fig. 5-1.)

3.10 INPUT CIRCUIT. The signal to be measured is connected to the tip and ring of the appropriate input jacks and is fed through a DC blocking capacitor and a series of switching networks which provide a hold circuit, a terminating mode of operation, a balanced transformer and/or an input attenuator network.

a. The hold circuit consists of a 500Ω dc resistance hold coil which can be activated by depressing the HOLD pushbutton (S1).

b. The purpose of the DC blocking capacitor is to block and eliminate any direct current voltages existing on the circuit under test from entering the circuitry of the transmission test set, which could damage components.

c. The next switchable selected component is a transformer (T1) with a one-to-one ratio that can be placed in the input circuit by depressing the XFMR pushbutton. Placing this transformer into the circuit will increase the sets balance and common mode rejection.

e. The 40 dB attenuator and frequency adjustment circuit consists of a high input impedance network for the unit, a high and low frequency 40 dB attenuator adjustment and a high and low frequency balance adjustment. For the SENSITIVITY switch (S4) positions from +20 dB to -10 dB resistors R301, R302, R307 and R308 constitute a 40 dB attenuator. Working in conjunction with these resistors are three capacitors (C301, C304 and C305) used to set up the proper high frequency attenuation. A trimmer capacitor, C301, is used to adjust for a proper high frequency response. Also on this board is a low frequency balance adjustment circuit consisting of two 390KΩ resistors (R304 and R306), a 500KΩ potentiometer (R304), a high frequency balance circuit consisting of a 5pf capacitor (C303) and a 1.5 to 8pf trimmer capacitor (C302).

3.11 BALANCED AMPLIFIER. The balanced amplifier is a dual input, single-ended 8-transistor wide band amplifier that has greater than 100KΩ input impedance. The input signal is AC coupled by the use of two 2.2μF non-polarized capacitors, (C202 and C203). Each of the two inputs look into a complimentary two-stage amplifier whose gain is automatically changed to compensate for input level changes when changing input impedance. The outputs of this two-stage amplifier are AC coupled to the final stages of the balanced amplifier by two more 2.2μF capacitors. The gain of the final stage is adjusted by means of a potentiometer, R230A, for +10 dB. The gain determining feedback resistance is comprised of R230, in series with a potentiometer, R230A, both in parallel with R228. Compensation for a proper high frequency response is obtained by a network comprised of a trimmer capacitor (C206) and a resistor (R232), to have an optimum flatness. The final stage of the balanced amplifier is an emitter-follower circuit that is used so no phase inversion occurs in this circuit and to present a low output impedance. The output is then AC coupled to the next circuit. There is also provision on the board for making noise to ground measurements.

3.12 PLUG-IN NETWORKS. The plug-in networks are optional equipment for the selection of various filters and networks. (Refer to the TTS 37D/E series, option section).

3.13 10-20-30 dB ATTENUATOR. The 10-20-30 dB attenuator is a voltage divider network made up of four precision resistors, R401 to R404, arranged with the proper switching configuration to give steps of 10 dB of loss to the circuit. Refer to the level diagram, Fig. 3-2, to see how this attenuator is incorporated into the circuit.

3.14 20 dB AMPLIFIER. This amplifier is a three-stage amplifier used to place 20 dB of gain into the circuit when the SENSITIVITY switch (S4) is in the two most sensitive positions, -60 dB and -70 dB. The amplifier incorporates two common emitter stages, Q501 and Q502, and an emitter-follower stage, Q503. An adjustable resistor, R507, is used to adjust for the proper amount of gain by varying the amount of resistance in the feedback loop.

3.15 20-30 dB AMPLIFIER. The 20-30 dB amplifier is a three-stage amplifier that can be switched from 20 dB of gain to 30 dB of gain in increments of 1 dB, and is used as a 1 dB step attenuator for the entire circuit, as represented by the DBM/DBRN switch, S11. The amplifier incorporates two common emitter stages (Q601 and Q602) for gain and an emitter follower stage, Q603, at the output. An adjustable resistor, R608, is used to adjust the amplifier for an initial gain of 20 dB. To establish the 1 dB step attenuator effect, precision resistors (1%), R13 to R4, of increasing values are switches in the feedback loop of the amplifier, decreasing the negative feedback loop of the amplifier and thus increasing the gain of the amplifier. Also in the feedback loop is a vernier level adjustment variable resistor, R3, that has a level adjustment of

approximately ±1.5 dB. This vernier level adjust is operated by the VERNIER OUT switch, S12, that is concentric with the DBM/DBRN switch, S11.

3.16 Q-RMS DETECTOR. The Q-RMS detector is a wide-band ac to dc converter that provides -20 dB of sensitivity and has two modes of operation, quasi-RMS and average responding. The input signal is fed through a two-stage amplifier comprised of Q701 and Q703. Bootstrap amplifier, Q702, is used to increase the impedance looking into the collector of Q703. Transistors Q704, Q705, Q706 and Q707 are used as rectifiers which provide current to the meter. Transistors Q704 and Q705 are used to provide peak detected current for the meter, and transistors Q706 and Q707 are used to provide average value current for the meter. The RMS/AVG switch, S15, is used for selecting meter current from the average value or taking a combined output from Q704 and Q707 on one side and Q705 and Q706 on the other side of the meter, to produce a quasi-RMS output current for the meter.

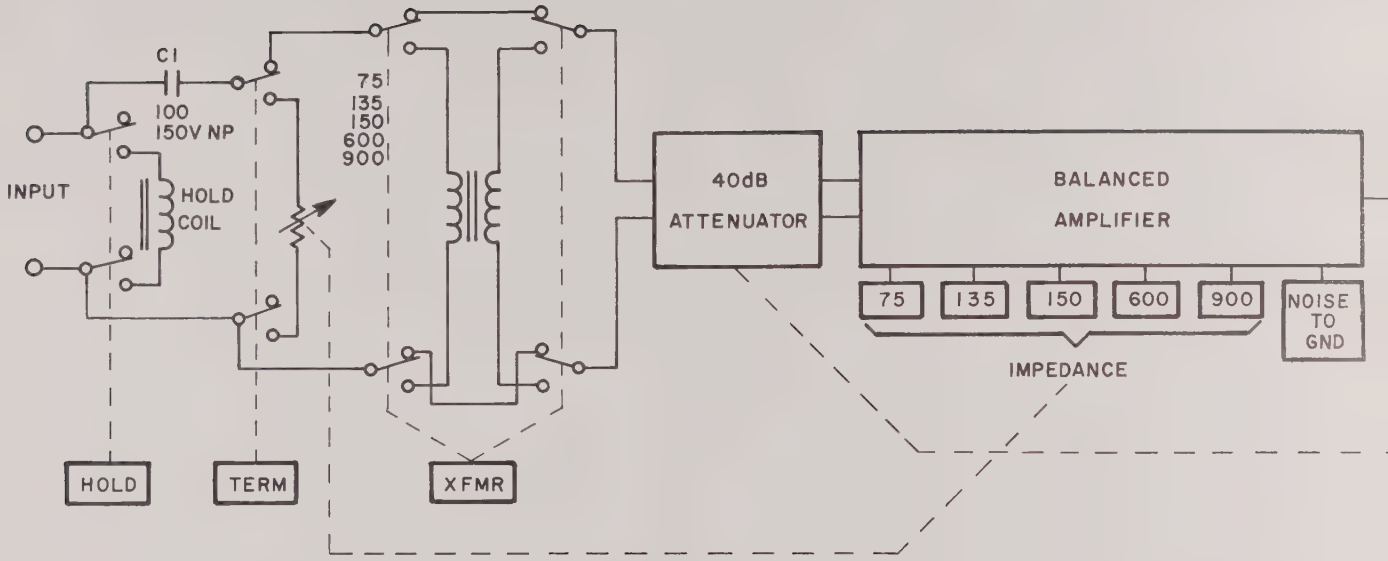
3.17 The output from these stages is combined beyond the meter and enters a feedback network that is comprised of a high frequency compensating network, R726, C712 and C713 to produce a wide-band response and a gain adjustment network to regulate the negative feedback comprised of R723, R724 and R725. The feedback path is then fed back to the emitter of Q701.

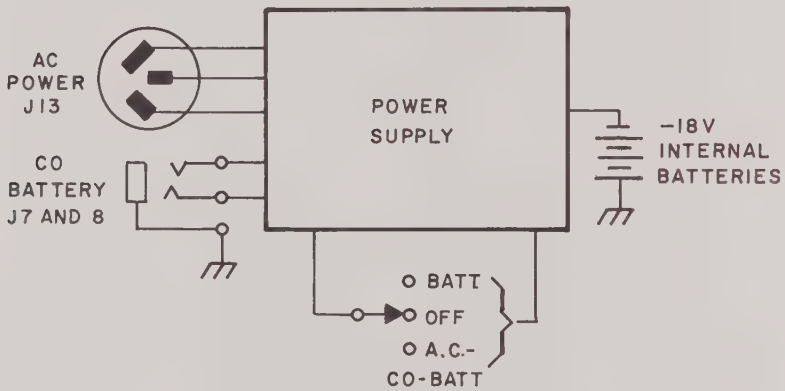
3.18 Also incorporated in this circuit is an ac and dc monitoring network, the inputs of which are taken off the emitters of Q707 and Q706, fed through a comparitor network, comprised of Q708 and Q709. The outputs from the collectors of these two transistors are the outputs for the DC monitoring circuit, J2. Note that neither side of the output jack is connected to circuit (chassis) ground. A dc current of approximately 0.1mA is supplied at the dc monitor jack with a meter reading of 0 dBm and can be adjusted by use of potentiometer R716. The ac monitoring circuit is taken between the common emitter resistor of Q708 and Q709 and ground. The signal is ac coupled to the ac monitor jack J1.

3.19 POWER SUPPLY. A regulated -12V dc is required for the correct operation of this instrument. This operating voltage can be obtained from any of three power sources, either 115V ac, CO battery or by internal batteries (18V dc). AC line voltage is fed from the AC power receptacle to a low pass filter, comprised of L801, L802, C801 and C802, through a 1/10 amp fuse to the primary of a power transformer, T2. The voltage from the secondary of the transformer is fed into a full-wave rectifier comprised of CR901, CR902, CR903 and CR904. The input from the CO battery power is isolated by two diodes (CR905 and CR906) so that no feedback occurs between the AC power source and the CO battery source.

3.20 A voltage of 18V is established by the zener diode, CR907, with R901 supplying the current for the diode. The output is provided by a compound transistor connection, comprised of Q901 and Q902. The voltage from this stage of the power supply is fed to one pole of the three-pole power switch, S13. The center pole of the switch is the off position and the third pole connected to the internal batteries. The wiper of the switch is connected to the input of the second stage of the power supply and to the battery test resistor (R727) located on the Q-RMS detector board. Thus, with the POWER switch in either one of the ON positions, BATT or CO-AC BATT, 18V is fed into the second stage of the power supply to be further regulated and reduced to a usable 12V.

3.21 Transistors Q903 and Q904 are used in Darlington configuration to improve the regulation of the output voltage. Transistors Q905 and Q906 are used as feedback amplifiers to sustain a constant output voltage and are used in conjunction with a reference zener diode, CR908.





POWER S-13

SENSITIVITY SWITCH	40 dB ATTENUATOR	40dB ATTN. OUT PUT	BALAN AMPL
+20 dB	- 40 dB	-20dB	+10
+10 dB	-40 dB	-30dB	+10
0	-40dB	-40dB	+10
-10dB	-40dB	-50dB	+10
-20dB	0dB	-20dB	+10
-30dB	0 dB	-30dB	+10
-40dB	0dB	-40dB	+10
-50dB	0dB	-50dB	+10
-60dB	0dB	-60dB	+10
-70dB	0dB	-70dB	+10

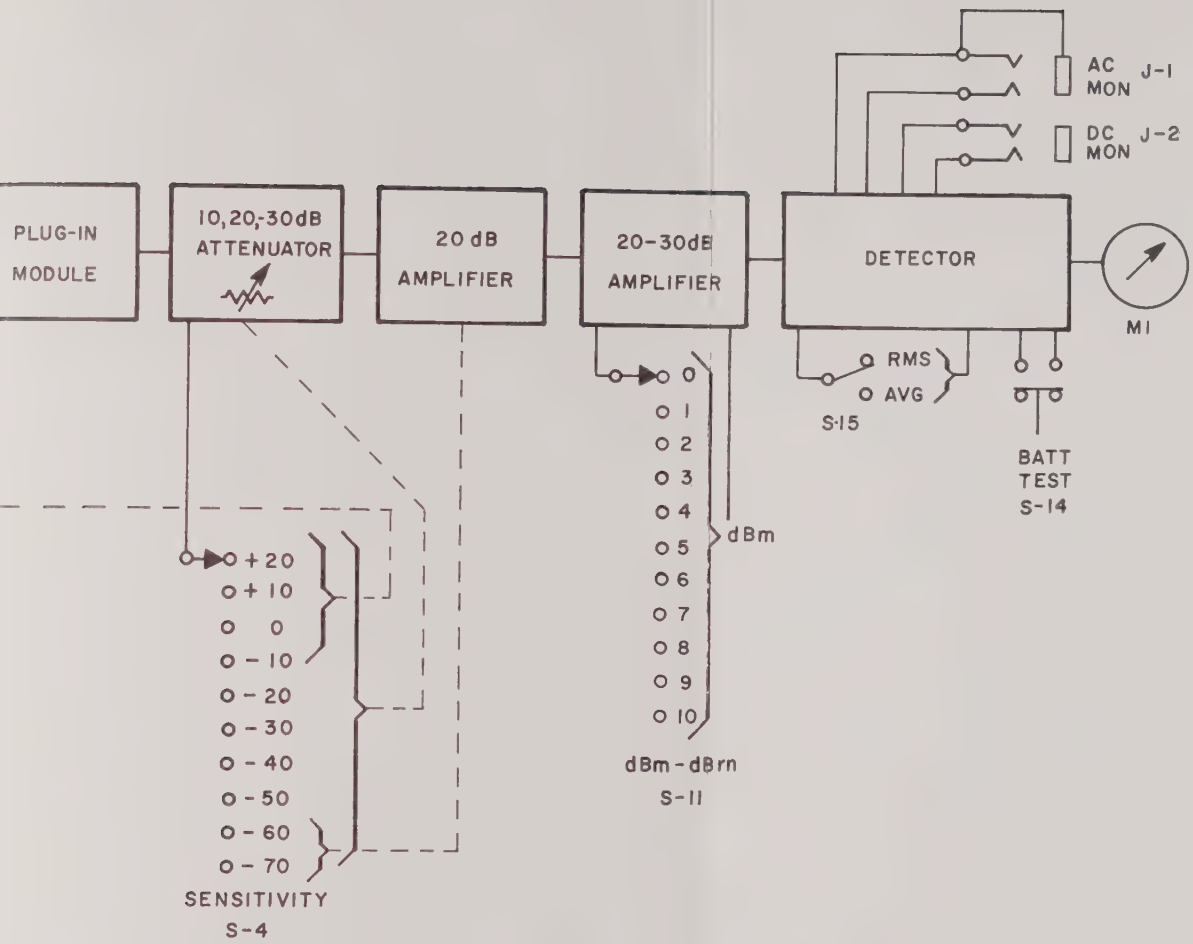


Fig 3-1 TTS 37E Block Diagram

LEVEL DIAGRAM

BAL. AMP. OUT PUT	10, 20, 30dB ATTENUATOR	10, 20, 30 dB ATTEN. OUT PUT	20dB AMPLIFIER	20dB AMP OUT PUT	20-30dB AMPLIFIER	20-30dB AMP OUT PUT	Q-RMS DETECTOR	METER INDICATION
-10dB	-30dB	-40dB	0 dB	-40dB	+20dB	-20dB	+20dB	0 dB
-20dB	-20dB	-40dB	0 dB	-40dB	+20dB	-20dB	+20dB	0dB
-30dB	-10dB	-40dB	0 dB	-40dB	+20dB	-20dB	+20dB	0 dB
-40dB	0 dB	-40dB	0 dB	-40dB	+20dB	-20dB	+20dB	0 dB
-10dB	-30dB	-40dB	0 dB	-40dB	+20dB	-20dB	+20dB	0 dB
-20dB	-20dB	-40dB	0dB	-40dB	+20dB	-20dB	+20dB	0dB
-30dB	-10dB	-40dB	0dB	-40dB	+20dB	-20dB	+20dB	0dB
-40dB	0dB	-40dB	0dB	-40dB	+20dB	-20dB	+20dB	0dB
-50dB	-10dB	-60dB	+20dB	-40dB	+20dB	-20dB	+20dB	0dB
-60dB	0dB	-60dB	+20dB	-40dB	+20dB	-20dB	+20dB	0dB

Fig 3-2 TTS 37E Level Diagram

SECTION 4

MAINTENANCE AND CALIBRATION

4.1 MAINTENANCE. Little or no maintenance is required for this transmission level measuring set other than replacement of batteries when they become weak. Batteries can be checked by depressing the BATT TEST pushbutton with the power on and observing a meter deflection within the green arc. This denotes good batteries. Replacement may be accomplished by loosening the four captive screws denoted by arrows on the front panel and lifting the unit from its protective case. The battery tray can be removed by unscrewing the captive screw and sliding the battery tray to the right. Disconnection of the plastic plug can be accomplished by applying slight pressure to both sides of the plug and pulling out.

4.2 CALIBRATION. This unit has been carefully calibrated and tested before shipment and should not need recalibration except in cases of age or misuse. If recalibration is required, the following steps should be taken using the recommended equipment shown in Table 4-1.

4.3 Table 4-2 represents a brief description and location of all calibration adjustment potentiometers and trimmer capacitors.

TABLE 4-1

Description	Manufacturer & Model
1. AC Voltmeter	HP 400FL or equivalent
2. Signal Generator - 100 Hz to 1 MHz capability normally 0 dBm output (75 and 600Ω output impedance)	HP 652A or equivalent
3. High frequency oscilloscope	Tektronix 535 or equivalent
4. Attenuation network	Daven type VT795G or equivalent
5. VTVM	Triplett Model 630NA or equivalent

TABLE 4-2

Location	Ref. Desig.	Purpose
Board #2 Balanced Amplifier	R230A	Adjust for approximately 10 dB of gain of the balanced amplifier.
	C206	Adjust for an optimum frequency response for the balanced amplifier at 1 MHz.
Board #3 40 dB Atten. & Freq. Adj.	R301	Adjust for 40 dB of attenuation at 1 kHz.
	R305	Adjust for input balance at 1 kHz.
	C301	Adjust for high freq. 40 dB attenuation.
	C302	Adjust for input balance at 100 kHz.
Board #5 20 dB Amplifier	R507	Adjust for approximately 20 dB of gain of the 20 dB amplifier.
Board #6 20-30 dB Amp.	R608	Adjust for approximately 20 dB of gain of the 20-30 dB amplifier.
Board #7 Q-RMS Detector	R725	With an input of 0 dBm at 1 kHz, adjust for a 0 dBm meter output (M1) with the RMS/AVG switch (S15) in RMS position.
	R730	With an input of 0 dBm at 1 kHz, adjust for a 0 dBm meter output (M1) with the RMS/AVG switch (S15) in AVG position.
	C713	Adjust for a 0 dBm meter output (M1) with an output of 0 dBm at 1 MHz with the RMS/AVG switch (S15) in the RMS position.
	R716	With meter reading of 0 dBm, adjust for output of 100μA current at the DC MON jack (J2).

4.4 Set the front panel controls on the TTS 37E as follows:

CONTROL	SETTING
POWER Switch	ON (either BATT or AC-CO BATT, whichever is selected).
RMS/AVG Switch	RMS
DBM/DBRN Switch	0 dBm
VERNIER OUT	DETENT position
SENSITIVITY Switch	-20 dBm
IMPEDANCE Pushbutton	600Ω
OPER Turnbutton	OPER
TERM Pushbutton	Released
XFMR Pushbutton	Released
HOLD Pushbutton	Released

4.5 LOW FREQUENCY (1 kHz)

4.6 40 dB ATTENUATOR and FREQ ADJ. Monitor the output (pin 8) of the balanced amplifier (Board #2, E95273) with AC voltmeter and adjust the input level at 1 kHz (600Ω) for an output level of the balanced amplifier of -10 dBm. Switch the SENSITIVITY switch (S4) to the -10 dBm position. The output of the balanced amplifier should drop to a level of approximately -50 dBm. Adjust potentiometer R301 on the 40 dB attenuator board (Bd. #3, E95352) for a drop of 40 dBm. Still monitoring the output of the balanced amplifier with an AC voltmeter, reverse the polarity of the input signal to the set without changing any other controls. Adjust potentiometer R305 on the 40 dB Attenuator board until no change in the level is appreciably noticed with a reversal of the input signals polarity. Interaction between these two adjustments does occur and a readjustment of both may be required.

4.7 20 dB AMPLIFIER. Set the SENSITIVITY switch (S4) in the -60 dBm position and monitor the input of the 20 dB Amplifier (pin 9) for a level of -60 dBm with an AC voltmeter. Next, with the AC voltmeter, check pin 6 of the 20 dB amplifier (output) for a gain of approximately 20 dB and, if necessary, adjust potentiometer R507 for a correct gain.

4.8 20-30 dB AMPLIFIER. Set the SENSITIVITY switch (S4) in the -10 dBm position and monitor the output (pin 6) of the 20-30 dB amplifier with an AC voltmeter. Set the VERNIER OUT in the detented position.and set the dBm/dBrn switch (S11) in the -10 dBm position. Adjust the input level of the set for a -20 dBm (reference) reading on the AC voltmeter. Set the DBM/DBRN switch in the 0 dBm position and adjust potentiometer R608 located on the 20-30 dB amplifier board (Bd. #6, E95275) for a -30 dBm reading on the AC voltmeter. Reset the DBM/DBRN switch to the -10 dBm position and readjust the oscillator for a -20 dB level reading on the AC voltmeter and repeat until a ±0.1 dBm tracking is achieved for all positions of the DBM/DBRN switch.

4.9 Q-RMS DETECTOR. Set the front panel controls on the TTS 37E as follows, leaving all other controls in their initial settings.

CONTROL	SETTING
SENSITIVITY Switch	0 dBm
TERM pushbutton	DETENTED

Monitor the input level to the test set using the AC voltmeter and adjust the oscillator for a 0 dBm reading at 1 kHz. Adjust potentiometers R725 and R730, located on the Q-RMS board (Board #7, E95357), for an approximate mechanical mid-range setting. Next, adjust R230A, located on the balanced amplifier board (Board #2, E95273), for an approximate 0 dBm reading on the meter (M1). Adjust potentiometer R725 for a 0 dBm reading on the meter. Switch the RMS/AVG switch (S15) to the AVG position and adjust R730 for a 0 dBm indication on the meter. Switching the RMS/AVG switch should keep a constant reading of 0 dBm on the output meter with an input of 0 dBm to the test set.

4.10 SENSITIVITY SWITCH (S4). Tracking at 1 kHz of the SENSITIVITY switch should be ±0.dB from +20 dBm to -50 dBm setting, and ±0 dB for the -60 dBm and -70 dBm settings. Some adjustment of R301, located on the 40 dB Attenuator board (Board #3, E95352), may be required for this degree of accuracy.

4.11 HIGH FREQUENCY (100 kHz to 1 MHz) Set the front panel controls of the TTS 37E as follows:

CONTROL	SETTING
POWER Switch	ON (either BATT or AC-CO BATT, whichever is selected)
RMS/AVG Switch	RMS
DBM/DBRN Switch	0 dBm
VERNIER OUT	OUT position
SENSITIVITY Switch	-20 dBm
IMPEDANCE Switch	75Ω
OPER Turnbutton	OPER
TERM Pushbutton	Recessed
XFMR Pushbutton	Released
HOLD Pushbutton	Released

4.12 BALANCED AMPLIFIER. Monitoring the output of the balanced amplifier, pin 8, with an AC voltmeter and using 1 kHz (75Ω) as a reference, set the oscillator for 100 kHz (75Ω) at -20 dBm and increase to 1 MHz while noting for any peaking of the output signal of the balanced amplifier. Adjust trimmer capacitor C206, located on the Balanced Amplifier board (Board #2, E95273), so that there is a rising response curve at 1 MHz. Readjust the output level of the oscillator for a 0 dB meter reading at 1 kHz (75Ω). Increase the oscillator to 1 MHz and adjust C713, located on the Q-RMS detector board (Board #7, E95357), for a 0 dB indication on the meter.

4.13 40 dB ATTENUATOR. Set the SENSITIVITY switch (S4) in the -10 dBm position and after setting the level of the oscillator for 0 dB meter reading at 1 kHz (75Ω), increase the oscillator frequency to 1 MHz and adjust C301, located on the 40 dB Attenuator board (Board #3, E95352), for a 0 dB meter reading.

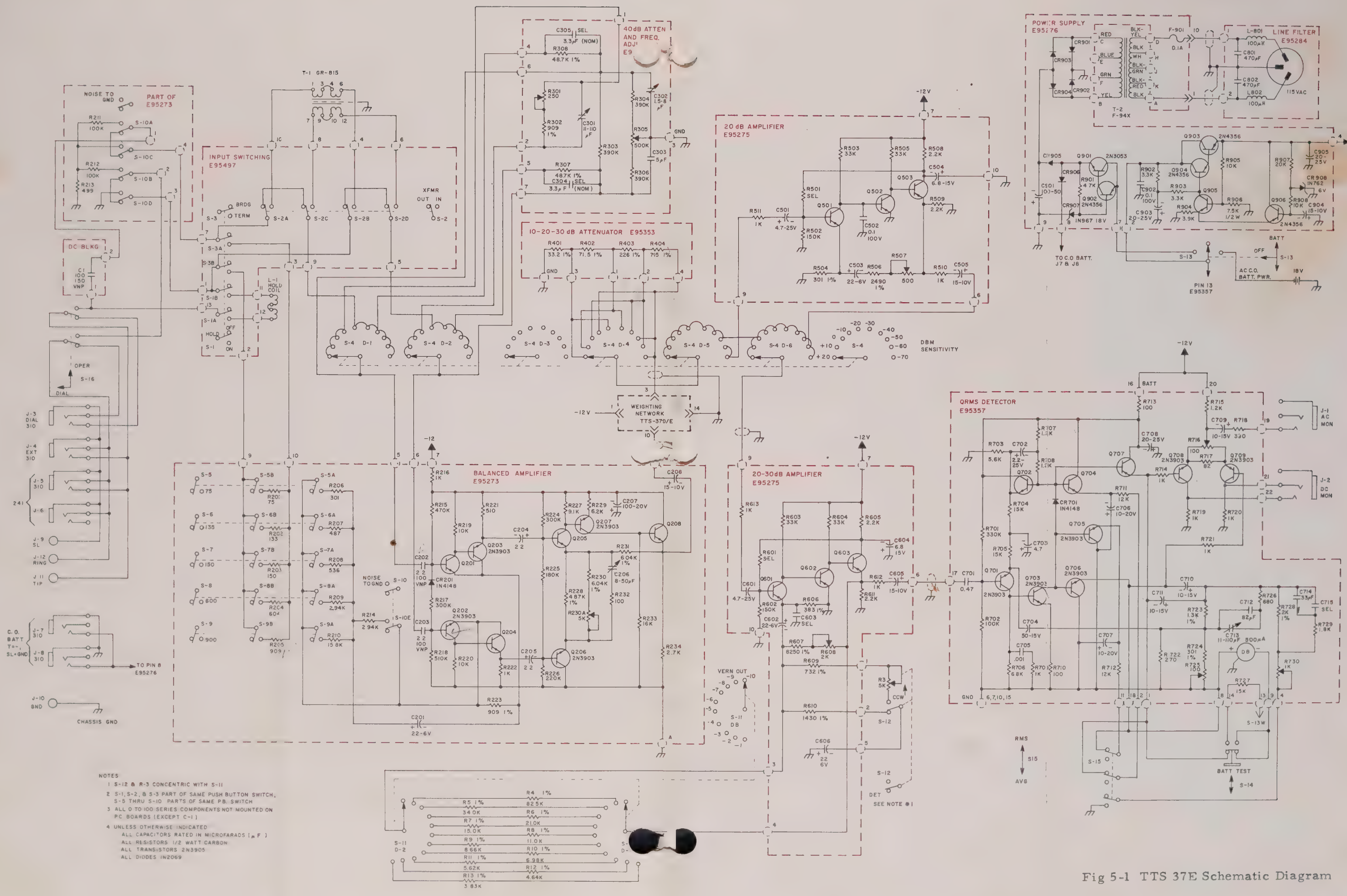
4.14 BALANCE. Set the SENSITIVITY switch (S4) to the -10 dB position and the oscillator for a 0 dB meter reading. Reverse the polarity of the input and adjust the trimmer capacitor C302, located on the 40 dB Attenuator board, so that no appreciable level change is noted with repeated reversal of the input signals polarity.

4.15 DC MONITOR. Set the SENSITIVITY switch (S4) in the 0 dBm position and feed a 0 dBm signal level at 1 kHz from the oscillator into the test set. Connect an ampmeter on the DC MON jack (J2) and adjust potentiometer R716, located on the Q-RMS Detector board for a reading of 100μA.

SECTION 5

SCHEMATIC DIAGRAMS

5.1 The following pages contain the schematic diagrams for the Model TTS 37E.



NOTES

1 S-12 & R-3 CONCENTRIC WITH S-11

2 S-1, S-2, & S-3 PART OF SAME PUSH BUTTON SWITCH. S-5 THRU S-10 PARTS OF SAME P.B. SWITCH

3 ALL 0 TO 100 SERIES COMPONENTS NOT MOUNTED ON P.C. BOARDS (EXCEPT C-1)

4 UNLESS OTHERWISE INDICATED
ALL CAPACITORS RATED IN MICROFARADS (μF)
ALL RESISTORS 1/2 WATT CARBON
ALL TRANSISTORS 2N3905
ALL DIODES IN2069

Fig 5-1 TTS 37E Schematic Diagram

SECTION 6

ELECTRONIC PARTS LIST

6.1 INTRODUCTION. The following pages contain the parts list for the Model TTS 37E.

6.2 FSCM Code Numbers. The Federal Supply Code of Manufacturers of each part. A list of these codes and their respective manufacturers is given below.

Code No.	Manufacturer
01121	Allen Bradley
02567	IEI
05397	Kemet
06288	Edal
07716	IRC
09353	C&K
12065	Transitron
13606	Sprague
15873	Motorola
17117	Electronic Molding Corp.
17803	Fairchild
71450	CTS
71590	Centralab
72962	Erie
75915	Littlefuse
76493	Miller
81073	Grayhill
81095	Triad
82389	Switchcraft
83330	H. H. Smith
86632	Newton
22650	Whale

NOTE: Pages 6-2 and 6-8 are not used in this section

Main Assembly

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
M1	Meter		6547-00
S1 to S3	S: pushbutton 3 section with push/push action	71590	2KDB021000-298
S4	S: rotary	71590	PA600-916-AAA
S5 to S10	S: pushbutton 6 section with interlocking action	71590	2KDC050100
S11 to S12	S: rotary	71590	PA620-040-0AA
S13	S: toggle	09353	7103
S14	S: pushbutton	82389	903
S15	S: toggle	09353	7301
J1 to J2	Jack: telephone	82389	L12B
J3 to J8	Jack: telephone	82389	5J-1329
J9 to J10	Binding posts: GND	83330	137-SP
J11	Binding post: red	17117	5595-175-2
J12	Binding post: blk	17117	5595-175-0
L1	Hold coil	86632	TN-1274
T1	Transformer	81095	GR815
C1	C: 100μF 150V	22650	34-875-100-150-8NA

The following resistors are located on S11.

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
R4	R: 82.5K ±1% 1/8W	07716	CEATO
R5	R: 34.0K ±1% 1/8W	07716	CEATO
R6	R: 21.0K ±1% 1/8W	07716	CEATO
R7	R: 15.0K ±1% 1/8W	07716	CEATO
R8	R: 11.0K ±1% 1/8W	07716	CEATO
R9	R: 8.66K ±1% 1/8W	07716	CEATO
R10	R: 6.98K ±1% 1/8W	07716	CEATO
R11	R: 5.62K ±1% 1/8W	07716	CEATO
R12	R: 4.64K ±1% 1/8W	07716	CEATO
R13	R: 3.83K ±1% 1/8W	07716	CEATO

Balanced Amplifier

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C201	C: 22μF 6V	05397	K22W6K
C202 and C203	C: 2.2μF 100V N.P.	22650	11-312-2.2-100-8NA
C204 and C205	C: 2.2μF 35V	05397	K2R2W35K
C206	C: 8-50pf	72982	539-00243E
C207	C: 100μF 20V	02567	APD-095
C208	C: 15μF 10V	05397	K10W10K
R201	R: 75Ω ±1% 1/8W	07716	CEATO
R202	R: 133Ω ±1% 1/8W	07716	CEATO
R203	R: 150Ω ±1% 1/8W	07716	CEATO
R204	R: 604Ω ±1% 1/8W	07716	CEATO
R205	R: 909Ω ±1% 1/8W	07716	CEATO
R206	R: 301Ω ±1% 1/8W	07716	CEATO
R207	R: 487Ω ±1% 1/8W	07716	CEATO
R208	R: 536Ω ±1% 1/8W	07716	CEATO
R209	R: 2.94K ±1% 1/8W	07716	CEATO
R210	R: 15.8K ±1% 1/8W	07716	CEATO
R211-R212	R: 100K ±1% 1/8W	07716	CEATO
R213	R: 499Ω ±1% 1/8W	07716	CEATO
R214	R: 2.94K ±1% 1/8W	07716	CEATO
R215	R: 470K ±5% ½W	01121	RC20
R216	R: 1K ±10% ½W	01121	RC20
R217	R: 300K ±5% ½W	01121	RC20
R218	R: 510K ±5% ½W	01121	RC20
R219-220	R: 10K ±10% ½W	01121	RC20
R221	R: 510Ω ±5% ½W	01121	RC20
R222	R: 1K ±10% ½W	01121	RC20
R223	R: 909Ω ±5% ½W	01121	RC20
R224	R: 300K ±5% ½W	01121	RC20
R225	R: 180K ±5% ½W	01121	RC20
R226	R: 220K ±10% ½W	01121	RC20
R227	R: 9.1K ±5% ½W	01121	RC20
R228	R: 4.87K ±1% 1/8W	07716	CEATO
R229	R: 6.2K ±10% ½W	01121	RC20
R230	R: 6.04K ±1% 1/8W	07716	CEATO
R230A	Pot: 5K	71450	UPE-200RE-1
R231	R: 6.04K ±1% 1/8W	07716	CEATO
R232	R: 100Ω ±10% ½W	01121	RC20
R233	R: 16K ±5% ½W	01121	RC20
R234	R: 2.7K ±5% ½W	01121	RC20
CR201	Diode	12065	1N4148
Q201	Transistor	15873	2N3905
Q202 and Q203	Transistors	15873	2N3903
Q204 and Q205	Transistors	15873	2N3905
Q206 and Q207	Transistors	15873	2N3903
Q208	Transistor	15873	2N3905

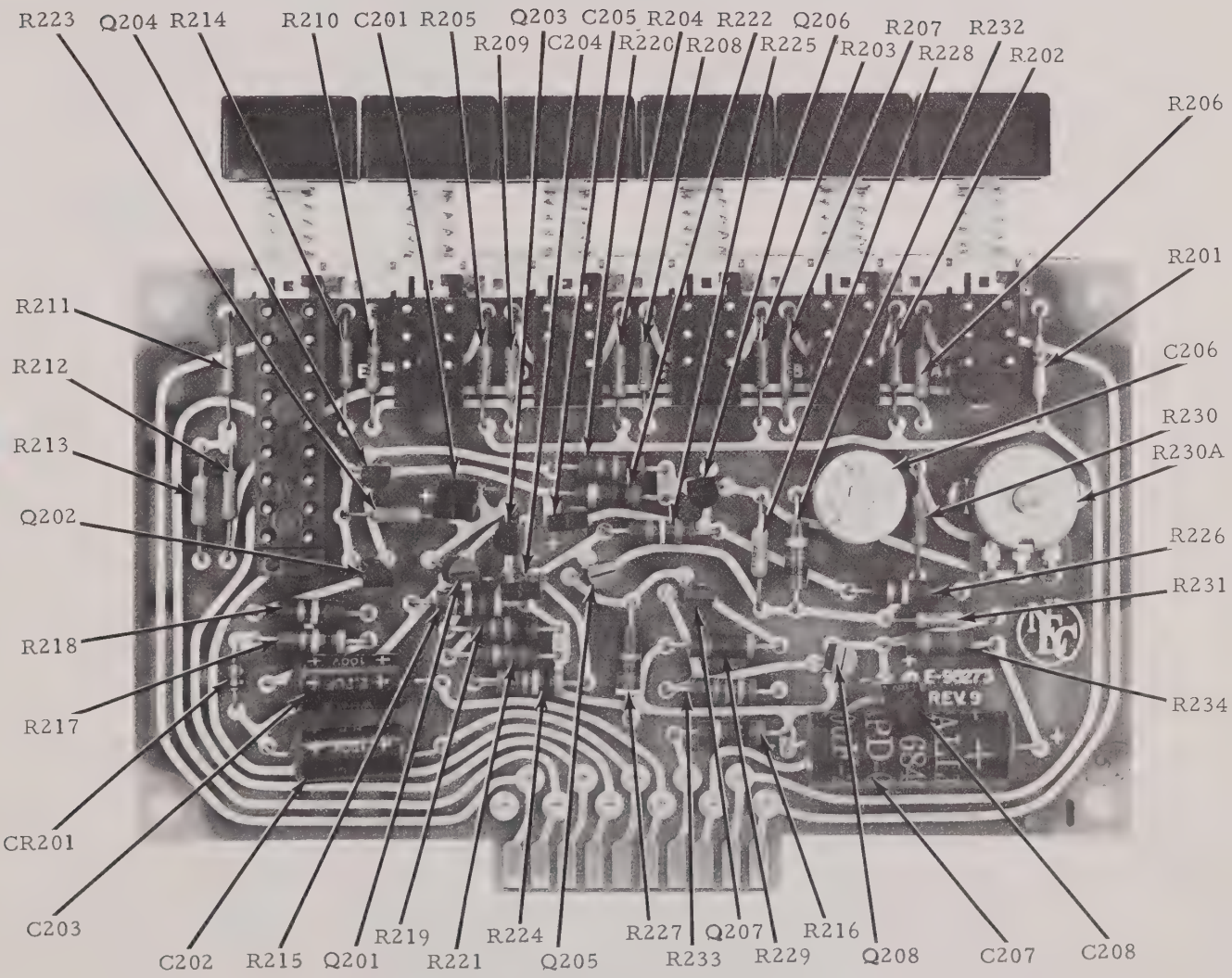


Fig. 6-1 Component Location E95273

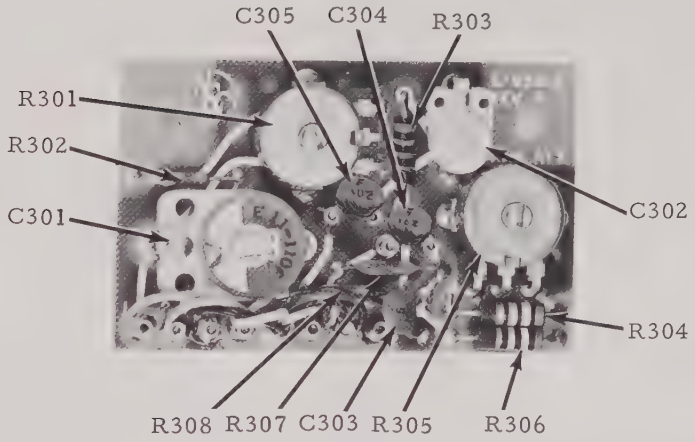


Fig. 6-2 Component Location E95352

40 dB Attenuator & Frequency Adjust

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C301	C: 11-110pf	72982	503-0016F
C302	C: 1.5-8pf	72982	539-00298A
C303	C: 5pf 1k	71590	DD-050
C304 and C305	C: sel val		
R301	Pot: 250Ω	71450	UPE-200RE-1
R302	R: 909Ω ±1% 1/8W	07716	CEATO
R303	R: 390K ±5% ½W	01121	RC20
R304 and R306	R: 390K ±5% ½W	01121	RC20
R305	R: 500K pot	71450	UPE-200RE-1
R307 and R308	R: 48.7K ±1% 1/8W	07716	CEATO

10-20-30 dB Attenuator

R401	R: 33.2Ω ±1% 1/8W	07716	CEATO
R402	R: 71.5Ω ±1% 1/8W	07716	CEATO
R403	R: 226Ω ±1% 1/8W	07716	CEATO
R404	R: 715Ω ±1% 1/8W	07716	CEATO

Fig. 6-3 Component Location E95353

20 dB Amplifier

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
C501	C: 4.7μF 25V	05397	K4R7W25K
C502	C: 0.1μF 100V	13606	225PW
C503	C: 22μF 6V	05397	K22W6K
C504	C: 6.8μF 20V	05397	K6R8W20K
C505	C: 15μF 10V	05397	K15W10K
R501	R: sel val		
R502	R: 150K ±5% ½W	01121	RC20
R503 and R505	R: 33K ±5% ½W	01121	RC20
R504	R: 301Ω ±1% 1/8W	07716	CEATO
R506	R: 2.67K ±1% 1/8W	07716	CEATO
R507	R: 500Ω pot	71450	UPE-200RE-1
R508 and R509	R: 2.2K ±5% ½W	01121	RC20
R510 and R511	R: 1K ±10% ½W	01121	RC20
Q501 thru Q503	Transistors	15873	2N3905

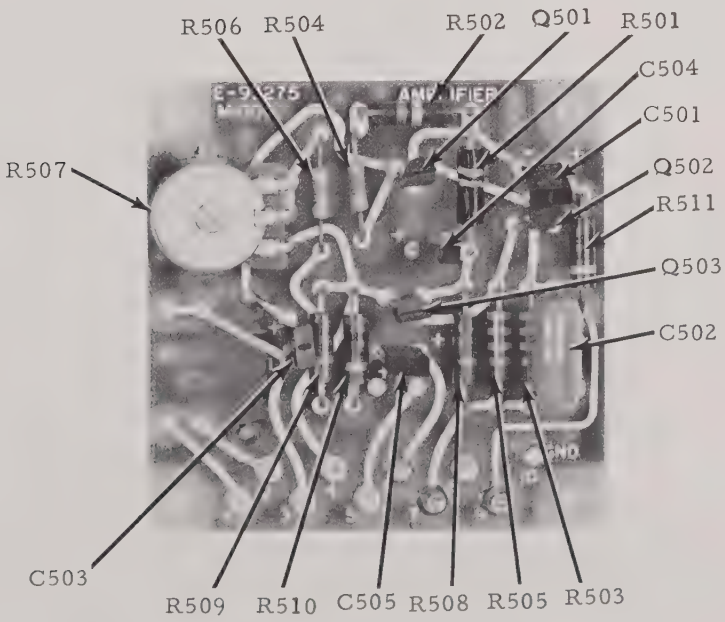


Fig. 6-4 Component Location E95275 (20 dB Amplifier)

20-30 dB Amplifier

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C601	C: 4.7μF 25V	05397	K4R7W25K
C602	C: 22μF 6V	05397	K22W6K
C603	C: sel val		
C604	C: 6.8μF 20V	05397	K6R8W20K
C605	C: 15μF 10V	05397	K15W10K
C606	C: 22μF 6V	05397	K22W6K
R601	R: sel val		
R602	R: 150K ±5% ½W	01121	RC20
R603 and R604	R: 33K ±5% ½W	01121	RC20
R605	R: 2.2K ±5% ½W	01121	RC20
R606	R: 383Ω ±1% 1/8W	07716	CEATO
R607	R: 8250Ω ±1% 1/8W	07716	CEATO
R608	R: 2K pot	71450	UPE-200RE-1
R609	R: 732Ω ±1% 1/8W	07716	CEATO
R610	R: 1430Ω ±1% 1/8W	07716	CEATO
R611	R: 2.2K ±5% ½W	01121	RC20
R612 and R613	R: 1K ±10% ½W	01121	RC20
Q601-603	Transistors	15873	2N3905

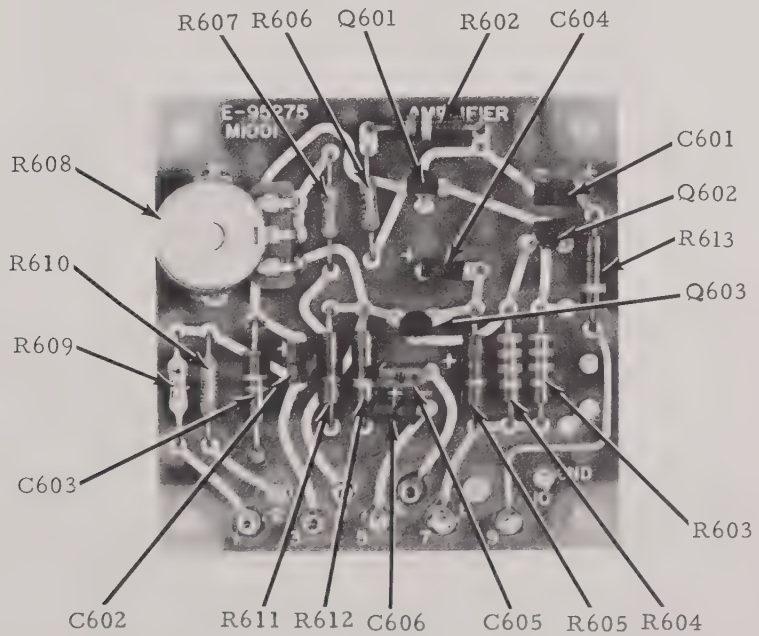


Fig. 6-5 Component Location E95275 (20-30 dB Amplifier

QRMS Detector

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C701	C: 0.47μF 75V	13606	225PW
C702	C: 2.2μF 35V	05397	K2R2W35K
C703	C: 4.7μF 25V	05397	K4R7W25K
C704	C: 50μF 15V	13606	TE-1160
C705	C: 0.001μF 1K	71590	DD-102
C706 and C707	C: 10μF 20V	13606	150D Series
C708	C: 20μF 25V	02567	APD-046
C709 thru C711	C: 10μF 15V	13606	TE-1155
C712	C: 82pf 1K	71590	DD-820
C713	C: 11-110pf	72982	557-09134E
C714	C: 33μF 1K	71590	DD-330
C715	C: sel val		
R701	R: 330K ±10% ¼W	01121	RC07
R702	R: 100K ±10% ¼W	01121	RC07
R703	R: 5.6K ±10% ¼W	01121	RC07
R704 and R705	R: 15K ±10% ¼W	01121	RC07
R706	R: 6.8K ±10% ¼W	01121	RC07
R707 and R708	R: 1.2K ±10% ¼W	01121	RC07
R709	R: 1K ±10% ¼W	01121	RC07
R710	R: 100Ω ±10% ¼W	01121	RC07
R711 and R712	R: 12K ±10% ¼W	01121	RC07
R713	R: 100Ω ±10% ¼W	01121	RC07
R714	R: 1K ±10% ¼W	01121	RC07
R715	R: 1.2K ±10% ¼W	01121	RC07
R716	R: 100Ω pot	71450	UPE-200RE-1
R717	R: 82Ω ±10% ¼W	01121	RC07
R718	R: 390Ω ±10% ¼W	01121	RC07
R719	R: 1K ±10% ¼W	01121	RC07
R720 and R721	R: 1K ±10% ¼W	01121	RC07
R722	R: 270Ω ±10% ¼W	01121	RC07
R723	R: 1.3K ±1% 1/8W	07716	CEATO
R724	R: 301Ω ±1% 1/8W	07716	CEATO
R725	Pot: 100Ω	71450	UPE-200RE-1
R726	R: 680Ω ±10% ¼W	01121	RC07
R727	R: 15K ±10% ¼W	01121	RC07
R729	R: 1.8K ±10% ¼W	01121	RC07
R728	R: 2K ±1% 1/8W	07716	CEATO
R730	R: 1K pot	71450	UPE-200RE-1
Q701	Transistor	15873	2N3903
Q702 thru Q704	Transistors	15873	2N3905
Q705 and Q706	Transistors	15873	2N3903
Q707	Transistor	15873	2N3905
Q708 and Q709	Transistor	15873	2N3903
CR701	Diode	12065	1N4148

Line Filter

C801 and C802	C: 470pf 1Kv	71590	CE471
L801 and L802	Ind: 100μH RF Choke molded	76493	9350-08

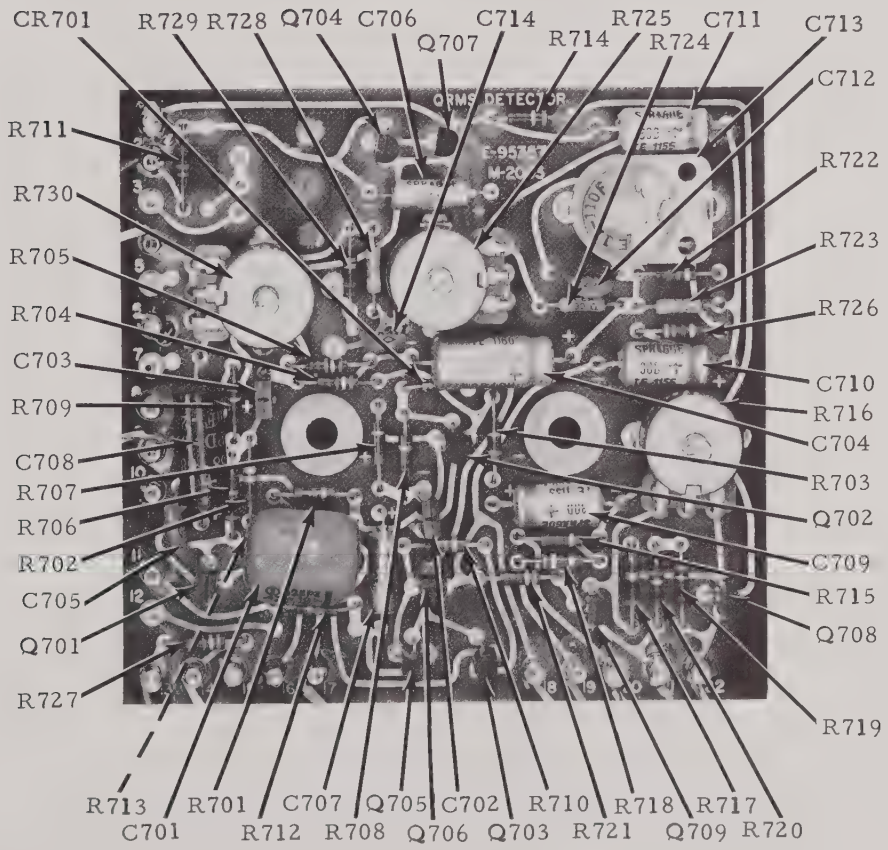


Fig. 6-6 Component Location E95357

Power Supply

Ref Desig.	Description	Manufacturer (FSCM Code NO)	Part Number
C901	C: 100μF 50V	22650	MDI-29-437-100-50
C902	C: 0.1μF 100V	13606	225PW
C903	C: 20μF 25V	02567	APD-046
C904	C: 15μF 10V	05397	K15W10K
C905	C: 20μF 25V	02567	APD-046
R901	R: 4.7K ±10% ½W	01121	RC20
R902 and R903	R: 3.3K ±10% ½W	01121	RC20
R904	R: 3.9K ±5% ½W	01121	RC20
R905	R: 10K ±10% ½W	01121	RC20
R906	R: 7.5K ±5% ½W	01121	RC20
R907	R: 20K ±5% ½W	01121	RC20
R908	R: 10K ±10% ½W	01121	RC20
F901	Fuse 1/10A	75915	3AG-1/10ASB
CR901 thru 906	Diodes	06288	1N2069
CR907	Diode: zener 18V	15873	1N967
CR908	Diode: zener 6v	12065	1N762
Q901	Transistor	49671	2N3053
Q902 thru 906	Transistors	17803	2N4356

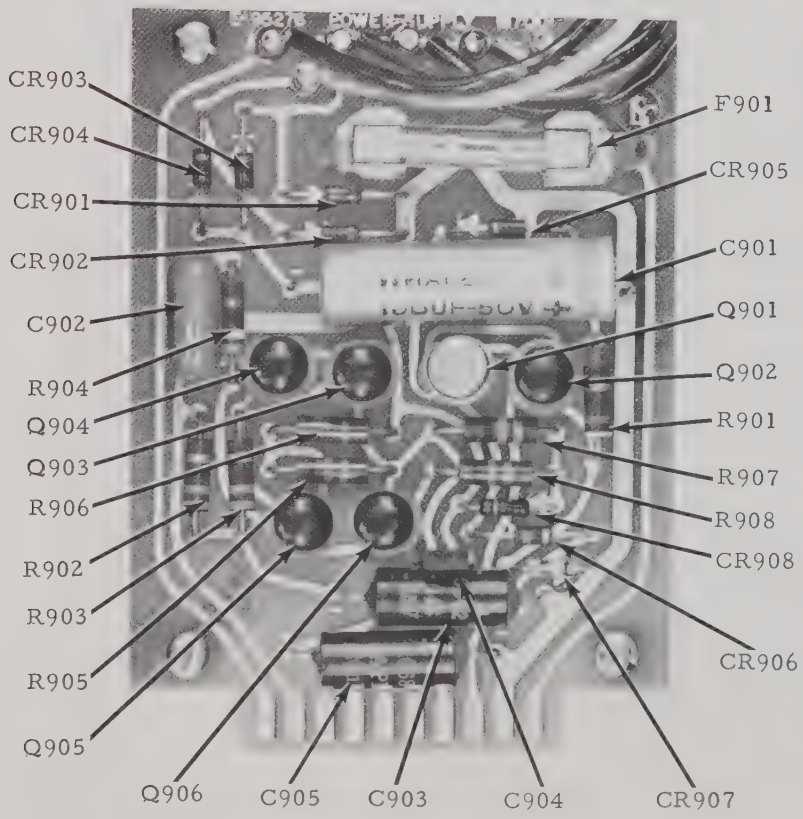


Fig. 6-7 Component Location E95276

SECTION 7

OPTIONS

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OPTIONS

INTRODUCTION. The TTS 37D/E modules are a series of optional plug-in units for use specifically with the TTS 37E Wide Band Transmission and Noise Measuring set. No modifications are required to change from one module to another.

TTS 37D/E-1

GENERAL. Used when only a flat response is required. Consists of a blank module with a shorting strap on the input plug.

TTS 37D/E-2

GENERAL. Consists of a flat response circuit and a C message weighting network.

DESCRIPTION. The C message filter network is used to properly weight the signal being measured. The circuit used is a 6-stage filter that has an insertion loss of 0 dB and matched input and output impedances.

SPECIFICATIONS

FREQUENCY RESPONSE (0 dB at 1.0 kHz)
-3 dB from 625 to 675 Hz and 2800 Hz to 3100 Hz
-40 dB from 85 Hz to 115 Hz and 6000 Hz to 7000 Hz

TTS 37D/E-3

GENERAL. Consists of a flat response circuit, a C message weighting network, a 3 kHz Low Pass Weighting Network and a 15 kHz Low Pass Weighting Network.

DESCRIPTION.

3 kHz LOW PASS FILTER. The 3 kHz Low Pass 3-stage weighting T network produces a low pass response curve with its -3 dB point at approximately 3 kHz. The filter has an insertion loss of 0 dB.

15 kHz LOW PASS FILTER. The 15 kHz Low Pass 3-stage weighting T network produces a low pass response curve with its -3 dB point at approximately 15 kHz. The filter has an insertion loss of 0 dB.

SPECIFICATIONS

Frequency Response Reference: 0 dB at 1.0 kHz

C Message

Frequency Response - 0 dB at 1.0 kHz
-3 dB from 625 to 675 Hz and 2800 Hz to 3100 Hz
-40 dB from 85 to 115 Hz and 6000 Hz to 7000 Hz

3 kHz Low Pass

-3 dB at 70 Hz $\pm$20 Hz and 3 kHz $\pm$600 Hz
Slope of -18 dB/octave

15 kHz Low Pass

-3 dB at 70 Hz $\pm$20 Hz and 15 kHz $\pm$3 kHz
Slope of -18 dB/octave

TTS 37E

TTS 37D/E-4

GENERAL. Consists of a flat response circuit, a C message weighting network, a 15 kHz Low Pass weighting network and a 300 Hz High Pass weighting network.

DESCRIPTION. The 300 Hz High Pass 3-stage weighting T network produces a high pass response curve with its lower -3 dB point at approximately 300 Hz and its upper -3 dB point at greater than 1 MHz. The filter has an insertion loss of 0 dB.

SPECIFICATIONS

Frequency Response Reference: 0 dB at 1.0 kHz

C Message

Frequency Response: 0 dB at 1.0 kHz
-3 dB from 625 to 675 Hz and 2800 Hz to 3100 Hz
-40 dB from 85 to 115 Hz and 6000 Hz to 7000 Hz

300 Hz High Pass

-3 dB at 300 Hz ±50 Hz
Upper -3 dB point same as flat response, greater than 1 MHz. Slope of -18 dB/octave

15 kHz Low Pass

-3 dB at 70 Hz ±20 Hz and 15 kHz ±3 kHz
Slope of -18 dB/octave

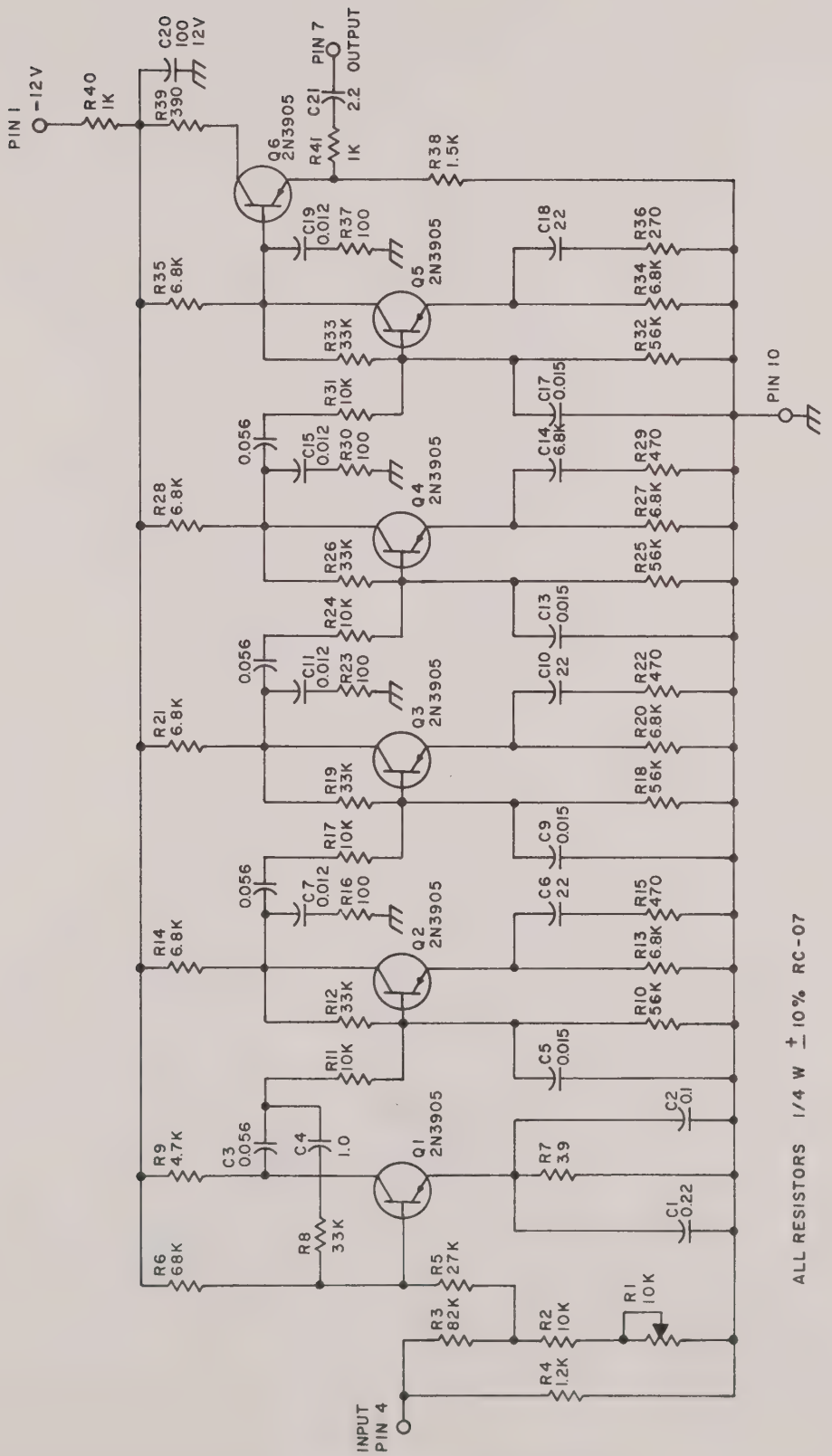

Fig. 7-1 Schematic Diagram E95362

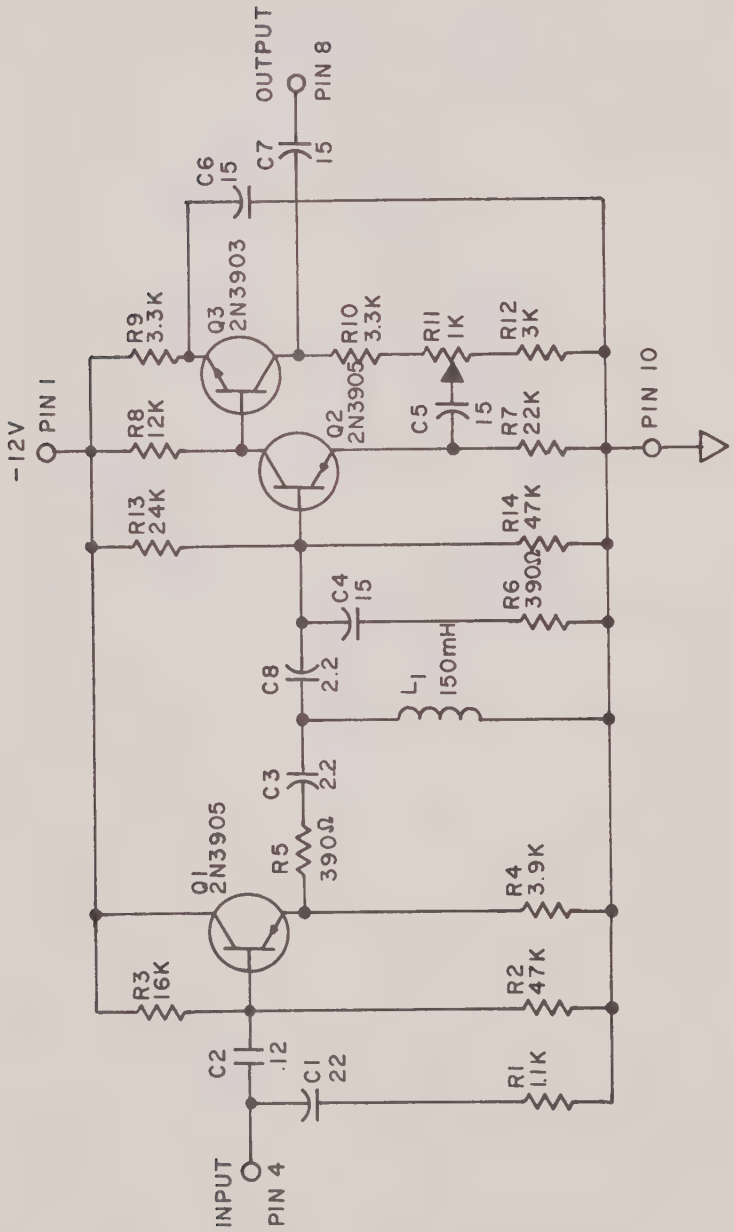

Fig. 7-2 Schematic Diagram E95417

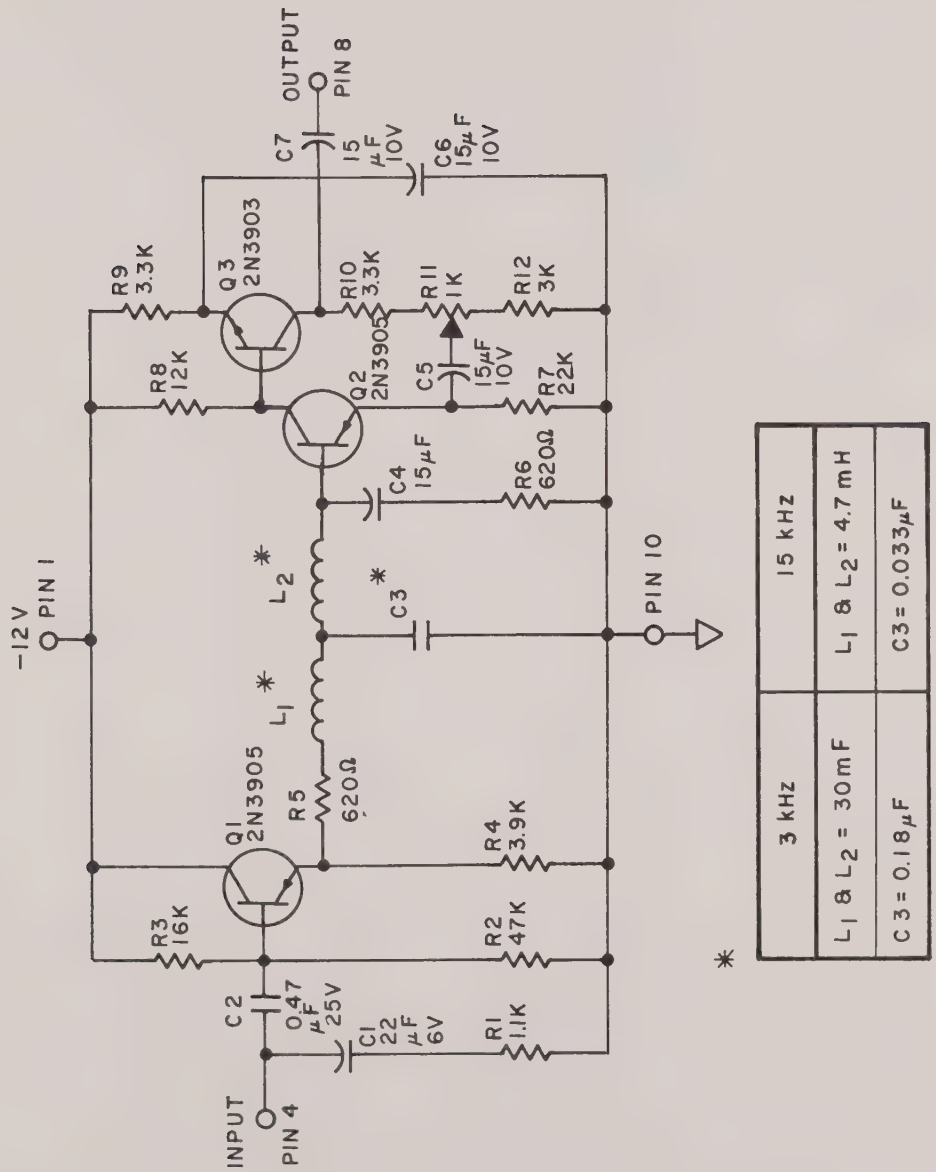

Fig. 7-3 Schematic Diagram E95418

C-Message Filter E95362

Ref Desig.	Description	Manufacturer's (FSCM Code No)	Part Number
C1	C: 0.22μF 50V	05397	KR22W50K
C2	C: 0.1μF 35V	05397	KR1W35K
C3	C: 0.0056μF 100V	13606	225P
C4	C: 1.0μF 35V	05397	K1RW35K
C5	C: 0.015μF 100V	13606	225P
C6	C: 22μF 6V	05397	K22W6K
C7	C: 0.012μF 100V	13606	225P
C8	C: 0.056μF 100V	13606	225P
C9	C: 0.015μF 100V	13606	225P
C10	C: 22μF 6V	05397	K22W6K
C11	C: 0.012μF 100V	13606	225P
C12	C: 0.056μF 100V	13606	225P
C13	C: 0.015μF 100V	13606	225P
C14	C: 22μF 6V	05397	K22W6K
C15	C: 0.012μF 100V	13606	225P
C16	C: 0.056μF 100V	13606	225P
C17	C: 0.015μF 100V	13606	225P
C18	C: 22μF 6V	05397	K22W6K
C19	C: 0.012μF 100V	13606	225P
C20	C: 100μF 12V	22650	16-375-100-12-8NPA
C21	C: 2.2μF 35V	05397	K2R2W35K
R1	Pot: 10K	07716	Type 500
R2	R: 10K ±10% $\frac{1}{4}$W	01121	RC07
R3	R: 82K ±10% $\frac{1}{4}$W	01121	RC07
R4	R: 1.2K ±10% $\frac{1}{4}$W	01121	RC07
R5	R: 27K ±10% $\frac{1}{4}$W	01121	RC07
R6	R: 68K ±10% $\frac{1}{2}$W	01121	RC07
R7	R: 3.9K ±10% $\frac{1}{4}$W	01121	RC07
R8	R: 33K ±10% $\frac{1}{4}$W	01121	RC07
R9	R: 4.7K ±10% $\frac{1}{4}$W	01121	RC07
R10	R: 56K ±10% $\frac{1}{4}$W	01121	RC07
R11	R: 10K ±10% $\frac{1}{4}$W	01121	RC07
R12	R: 33K ±10% $\frac{1}{4}$W	01121	RC07
R13 & R14	R: 6.8K ±10% $\frac{1}{4}$W	01121	RC07
R15	R: 470Ω ±10% $\frac{1}{4}$W	01121	RC07
R16	R: 100Ω ±10% $\frac{1}{4}$W	01121	RC07
R17	R: 10K ±10% $\frac{1}{4}$W	01121	RC07
R18	R: 56K ±10% $\frac{1}{4}$W	01121	RC07
R19	R: 33K ±10% $\frac{1}{4}$W	01121	RC07
R20 & R21	R: 6.8K ±10% $\frac{1}{4}$W	01121	RC07
R22	R: 470Ω ±10% $\frac{1}{4}$W	01121	RC07
R23	R: 100Ω ±10% $\frac{1}{4}$W	01121	RC07
R24	R: 10K ±10% $\frac{1}{4}$W	01121	RC07
R25	R: 56K ±10% $\frac{1}{4}$W	01121	RC07
R26	R: 33K ±10% $\frac{1}{4}$W	01121	RC07
R27 & R28	R: 6.8K ±10% $\frac{1}{4}$W	01121	RC07
R29	R: 470Ω ±10% $\frac{1}{4}$W	01121	RC07
R30	R: 100Ω ±10% $\frac{1}{4}$W	01121	RC07
R31	R: 10K ±10% $\frac{1}{4}$W	01121	RC07
R32	R: 56K ±10% $\frac{1}{4}$W	01121	RC07
R33	R: 33K ±10% $\frac{1}{4}$W	01121	RC07

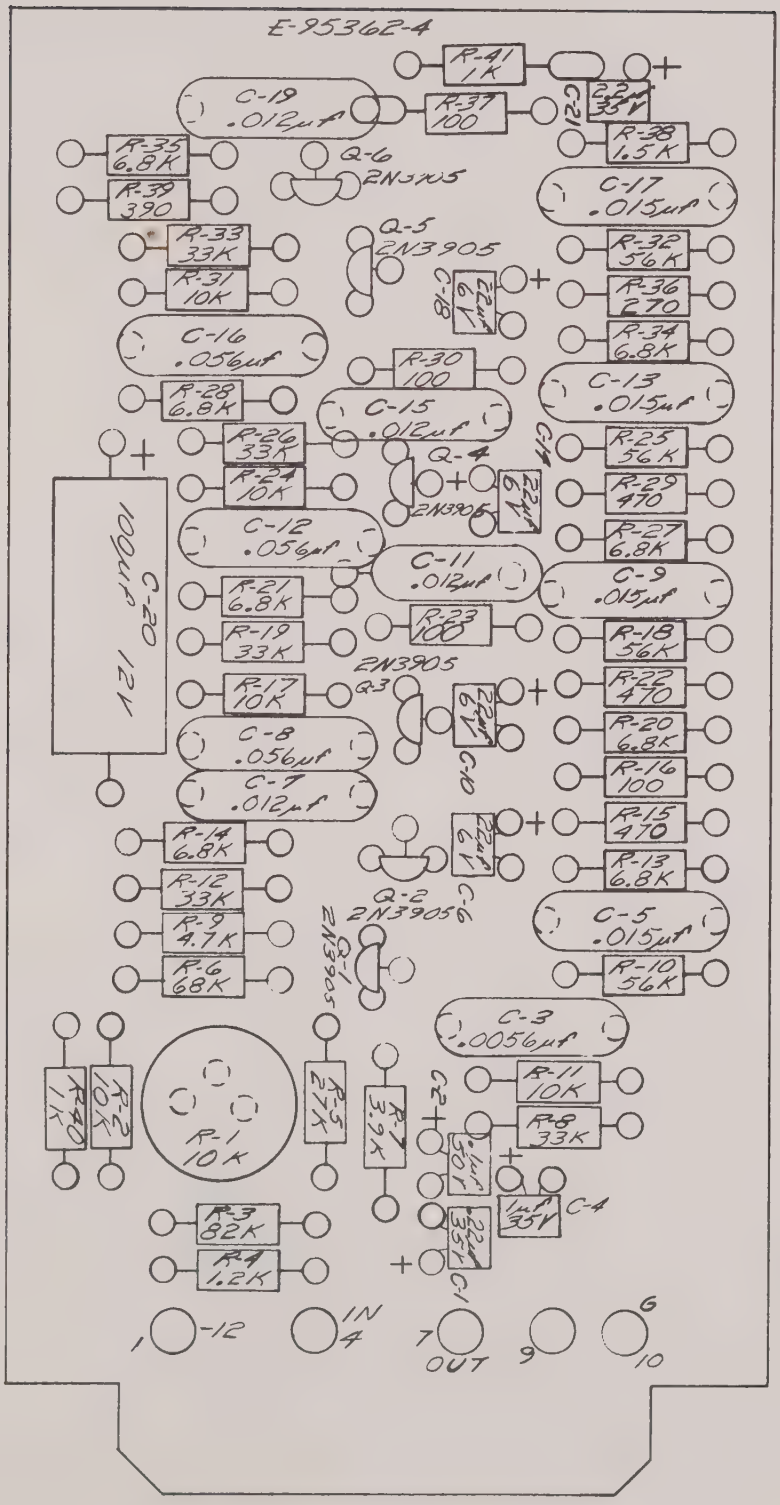

Fig. 7-4 Component Location E95362

C-Message Filter E95362 (cont.)

Ref Desig.	Description	Manufacturer's (FSCM Code #)	Part Number
R34 and R35	R: 6.8K ±10% ¼W	01121	RC07
R36	R: 270Ω ±10% ¼W	01121	RC07
R37	R: 100Ω ±10% ¼W	01121	RC07
R38	R: 1.5K ±10% ¼W	01121	RC07
R39	R: 390Ω ±10% ¼W	01121	RC07
R40 and R41	R: 1K ±10% ¼W	01121	RC07
Q1 thru Q6	Transistors	15873	2N3905

300 Hz High Pass Weighting Network E95417

Ref Desig.	Description	Manufacturer's (FSCM Code No.)	Part Number
C1	C: 22μF 6V	05397	K22W6K
C2	C: 0.12μF 75V	13606	225P
C3	C: 2.2μF 35V	05397	K2R2W35K
C4 thru C7	C: 15μF 10V	05397	K15W10K
C8	C: 2.2μF 35V	05397	K2R2W35K
R1	R: 1.1K ±5% ½W	01121	RC20
R2	R: 47K ±10% ½W	01121	RC20
R3	R: 16K ±5% ½W	01121	RC20
R4	R: 3.9K ±5% ½W	01121	RC20
R5 and R6	R: 390Ω ±5% ½W	01121	RC20
R7	R: 22K ±5% ½W	01121	RC20
R8	R: 12K ±10% ½W	01121	RC20
R9 and R10	R: 3.3K ±10% ½W	01121	RC20
R11	R: 1K potentiometer	07716	Type 500
R12	R: 3K ±5% ½W	01121	RC20
R13	R: 24K ±5% ½W	01121	RC20
R14	R: 47K ±10% ½W	01121	RC20
Q1 and Q2	Transistor	15873	2N3905
Q3	Transistor	15873	2N3903
L1	Ind: 150μH	81095	EA-150

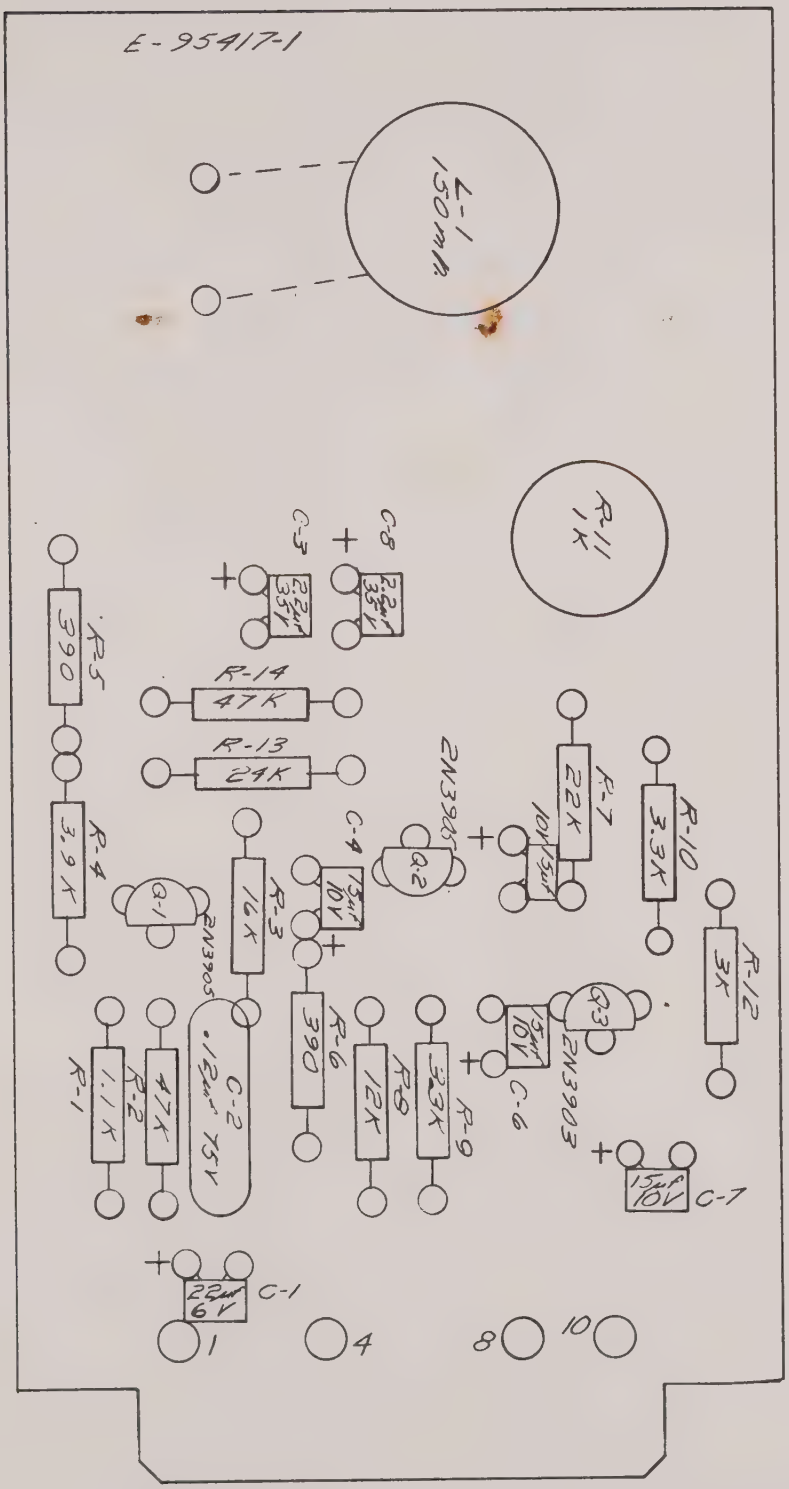

Fig. 7-5 Component Location E95417

3 kHz Low Pass Weighting Network E95418

Ref Desig.	Description	Manufacturer's (FSCM Code #)	Part Number
C1	C: 22μF 6V	05397	K22W6K
C2	C: 0.47μF 25V	13606	5C11
C3	C: 0.18μF 100V	13606	225P
C4 thru C7	C: 15μF 10V	05397	K15W10K
R1	R: 1.1K ±5% ½W	01121	RC20
R2	R: 47K ±10% ½W	01121	RC20
R3	R: 16K ±5% ½W	01121	RC20
R4	R: 3.9K ±5% ½W	01121	RC20
R5 and R6	R: 620Ω ±10% ½W	01121	RC20
R7	R: 22K ±5% ½W	01121	RC20
R8	R: 12K ±10% ½W	01121	RC20
R9 and R10	R: 3.3K ±10% ½W	01121	RC20
R11	R: 1K pot	07716	Type 500
R12	R: 3K ±5% ½W	01121	RC20
Q1 and Q2	Transistors	15873	2N3905
Q3	Transistor	15873	2N3903
L1 and L2	Ind: 30μH	81095	EA-30

15 kHz Low Pass Weighting Network E95418

C1	C: 22μF 6V	05397	K22W6K
C2	C: 0.47μF 25V	13606	5C11
C3	C: 0.033μF 100V	13606	225PW
C4 thru C7	C: 15μF 10V	05397	K15W10K
R1	R: 1.1K ±5% ½W	01121	RC20
R2	R: 47K ±10% ½W	01121	RC20
R3	R: 16K ±5% ½W	01121	RC20
R4	R: 3.9K ±5% ½W	01121	RC20
R5 and R6	R: 620Ω ±5% ½W	01121	RC20
R7	R: 22K ±5% ½W	01121	RC20
R8	R: 12K ±10% ½W	01121	RC20
R9 and R10	R: 3.3K ±10% ½W	01121	RC20
R11	Pot: 1K	07716	Type 500
R12	R: 3K ±5% ½W	01121	RC20
Q1 and Q2	Transistors	15873	2N3905
Q3	Transistor	15873	2N3903
L1 and L2	Ind: 4.7μH	99800	2500-60

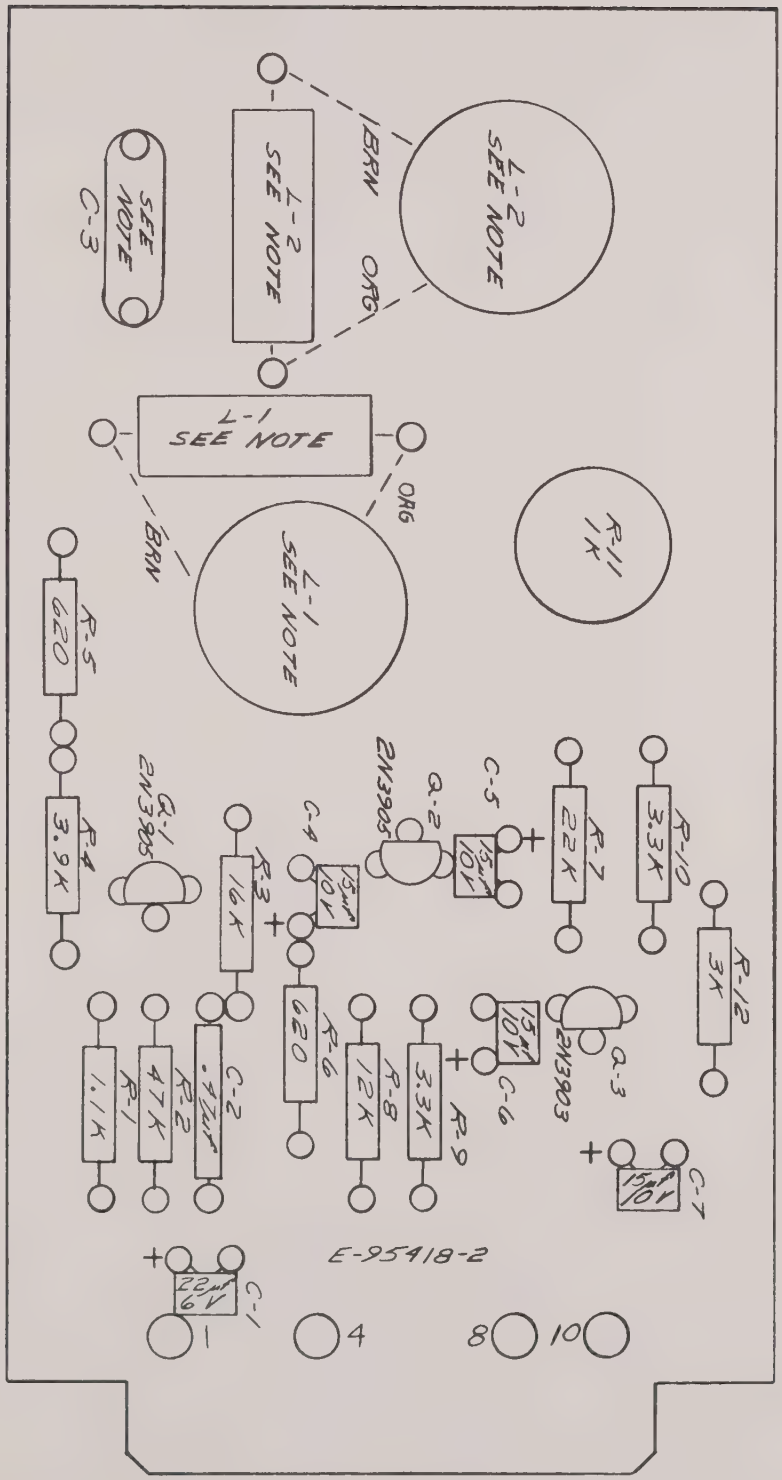

Fig. 7-6 Component Location E95418

85405